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The Dayton Swaging Machine.

The operation of cold-swaging metals, though comparatively little understood by mechanics generally, is one which, in certain lines, is developing very rapidly, and the indications are that the range of its applicability is as yet imperfectly known, even by those best acquainted with the process; since experience is always showing new lines of work to which it seems admirably adapted. Perhaps its most extended use has been in the manufacture of sewing machine needles, which, by a machine similar to those shown by our illustrations, are swaged down to size from a blank the diameter of the shank of the needle, automatic attachments being provided so that the machine needs only to be driven and kept supplied with blanks. At the works of the Excelsior Needle Co., Torrington, Conn., hundreds of these machines have been and are employed in this work of making sewing machine needles, and their use there has gradually extended to the swaging of bicycle spokes, gold-covered wire used by jewelers, the tubes of hypodermic syringes, as well as larger tubes of brass, copper, or steel, up to two inches or more diameter, and of any required thickness, the process being extremely rapid, and, in most cases, greatly increasing the strength of the metal operated upon, as will be shown more fully hereafter.

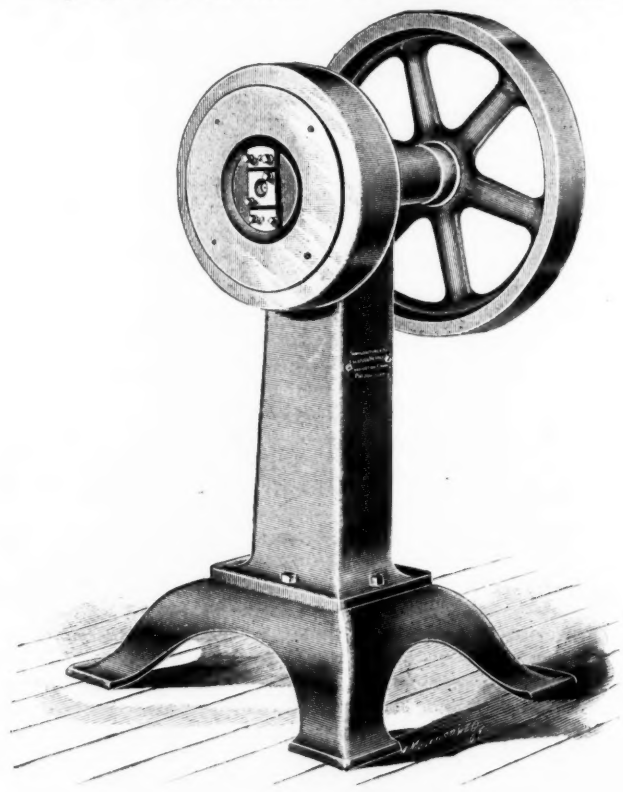
Varied experience with the machine has led to improvements in its details, and we show it in its latest form, the perspective engraving being made from one of the larger sizes, while the detail engravings are made from a smaller size designed to stand upon a bench.

Referring to the engravings it will be seen that the frame of the machine is bored out to receive a cast sleeve which is held from rotation by the set-screw at top. This sleeve is enlarged outside the frame to form the head, a wrought ring being shrunk onto it outside and a hardened and ground steel ring inside.

Within this last-named ring there is a floating ring (Fig. 3) carrying, loosely, hardened and ground steel rollers *R R*.

Running within the sleeve before mentioned is a steel shaft, to which the pulleys, fly-wheel, etc., are attached at the rear, and this shaft is enlarged at the inner end and slotted to receive the dies *B B* and blocks *C*, as shown at Fig. 4, these pieces being all free to move within the slot at right angles to the axis of the shaft.

The inner faces of the dies *B B* have formed in them the impression of the shape or diameter of work it is designed to produce, with an enlargement or flare at the outer or entering end large enough to allow the unreduced stock to enter; and, as the shaft *A*, by its revolution, causes the dies and rounded blocks (*C*) to pass between successive opposing pairs of rollers *R R*, the dies are closed together, and, as the stock being fed in does not revolve, but the dies revolve around it, and, the rollers being in a floating ring are also rotating within the head, but much more slowly, the effect of the dies is distributed about the stock very thoroughly, five closures of the dies taking place at each revolution in the small machine shown, for instance. Even these are, however, not distributed at exactly equal intervals, because the floating ring revolves somewhat irregularly, being moved only by the slight motion of the rollers during the time of contact with the blocks *C*. The plate *D* merely holds the dies in place, and plates *E* hold the blocks



THE DAYTON SWAGING MACHINE.

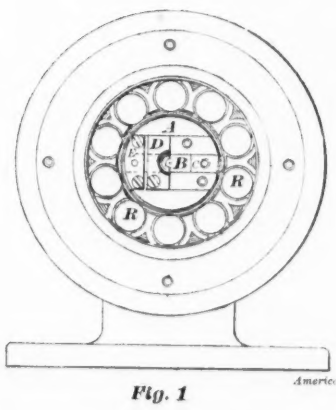


Fig. 1

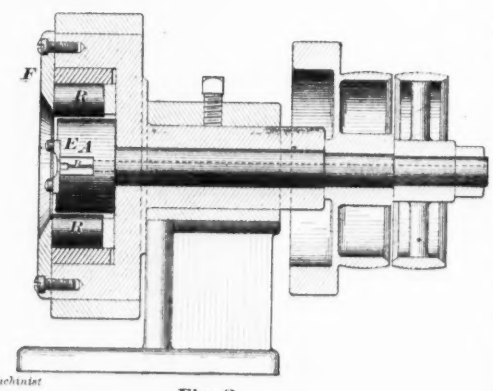


Fig. 2

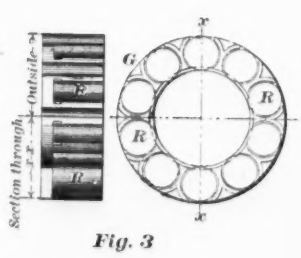


Fig. 3

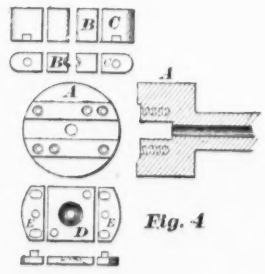


Fig. 4

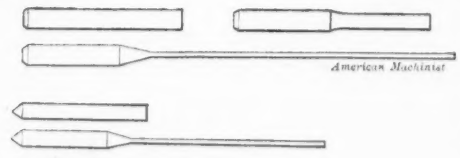


Fig. 5

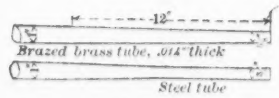


Fig. 6

C and also limit their outward motion, or the opening of the dies, by means of the small pins shown, which engage in holes in the blocks somewhat larger in diameter. The plates *E* can be adjusted to or from the center by means of the slotted holes shown. The plate *F* holds the rollers in place, and, being fastened to the head, does not revolve.

Fig. 5 gives an idea of the needle-swaging operation; the smaller needle being reduced at one operation. Its shank .08″ diameter is reduced to .028″ diameter, while the larger one is .115″ and is reduced to .083″ and .067″ diameter, respectively, at two operations, as indicated, without annealing.

One of the most surprising operations performed by the machine, perhaps, is in swaging tubing. Fig. 6 is a sketch of some work in this line; the upper piece being a brazed brass tube about 33 inches long, and 1 inch diameter, .014 inch thick. This is simply shoved into the revolving dies of the machine and tapered at one end for 12 inches in length, and down to ¼ inch diameter at the small end. Two operations were required for this, simply because where taper work is to be produced the dies must have a corresponding taper, and no machine was at hand which would use dies 12 inches long. The work was therefore done by two separate pairs of dies, used successively, coming out smoother and better finished than the original tube, without a sign of crimping, though entirely unsupported inside. These tubes were fed in and held by hand, and the work done about as fast as a boy could handle them.

The lower piece, shown in Fig. 6, is a steel tube 1 inch diameter reduced to ⅞ inch straight, by taper dies, leaving a taper section about 6 inches long. This tube was of hard steel about $\frac{1}{16}$ inch thick and was swaged down rapidly and smoothly.

The gauge or diameter of swaged work can be depended upon for accuracy, and in swaging brass or copper experience shows that less annealing is required than where the reduction is made by drawing through dies.

The applicability of the process to tubing for bicycle frames, etc., is shown by the fact that the writer saw steel tubing $\frac{1}{16}$ inch thick, 1 inch diameter, reduced to $\frac{7}{8}$ inch diameter, and when the straight reduced portion of the tube is 6 inches to 10 inches long, about five pieces per minute can be done. Tubes for bicycle frames are sometimes reinforced at certain points requiring extra strength, and this is done by simply inserting a short piece of smaller tubing at the desired point and swaging the outer tube down upon it.

Amongst the smallest and most delicate work done are tubes for hypodermic syringes, which are of steel with a hole through them .015 inch diameter when finished. Another example of small work is in making "rolled-plate" wire to be used by manufacturing jewelers. In making this wire a cylindrical piece of base metal about 1½ inches diameter is covered by a case of gold which is drawn in a drawing press from a flat blank the same as cartridge shells are drawn.

The gold case is soldered to the core and the whole is then reduced by these swaging machines to such diameters as are suitable for eye-glass chains, etc., some of it being swaged down to .015 inch diameter, finely finished, seamless and stronger and more durable than if made of solid gold.

A very considerable portion of the business of the Excelsior Needle Company is now the manufacture of bicycle spokes, the wire for which is taken from a coil, straightened, passed through the hollow spindle of a swaging machine and reduced to proper diameter by swaging, but leaving unswaged sections at proper intervals, which, when sheared in two at the middle, leaves the spokes large at each end for heading, bending and threading.

All this is done continuously and automatically, about fifty machines being constantly employed upon this alone.

Some tests of these spokes (in which the writer took part) show clearly the improvement in tensile strength resulting from the

swaging operation. The tests were made in a Riehlé wire-testing machine and first a piece of unswaged, hard, crucible-steel wire, .092 inch diameter, was broken by a stress of 1,100 pounds, giving a strength of 165,662 pounds per square inch. A piece of wire from the same coil, which had been swaged down to .072 inch diameter, was then broken at 735 pounds, giving a strength of 180,589 pounds per square inch. An increase of 14,927 pounds per square inch, or 9 per cent.

The second test was made in the same manner, but was of Bessemer steel wire, originally .105 inch diameter, swaged to .08 inch. This broke at 800 pounds and 535 pounds respectively, giving a strength unswaged of 92,485 pounds per square inch, and swaged, 107,000 pounds; an increase of 14,515 pounds, or 15 6 per cent.

Another test of crucible-steel wire, originally .115 inch diameter, swaged to .083 inch diameter, gave a breaking strength of 1,620 pounds and 960 pounds, respectively, or, 155,769 pounds and 177,777 pounds per square inch, respectively; an increase of strength by swaging of 22,008 pounds per square inch, or about 14 per cent. These tests, though not exhaustive, are sufficient to show that the swaging operation increases the tensile strength of steel which has been previously strengthened by being drawn into wire.

This machine is the invention of W. H. Dayton, superintendent, and five sizes are regularly built, and special sizes are constructed for special purposes by the company named above.

Eighteen-inch Lathe.

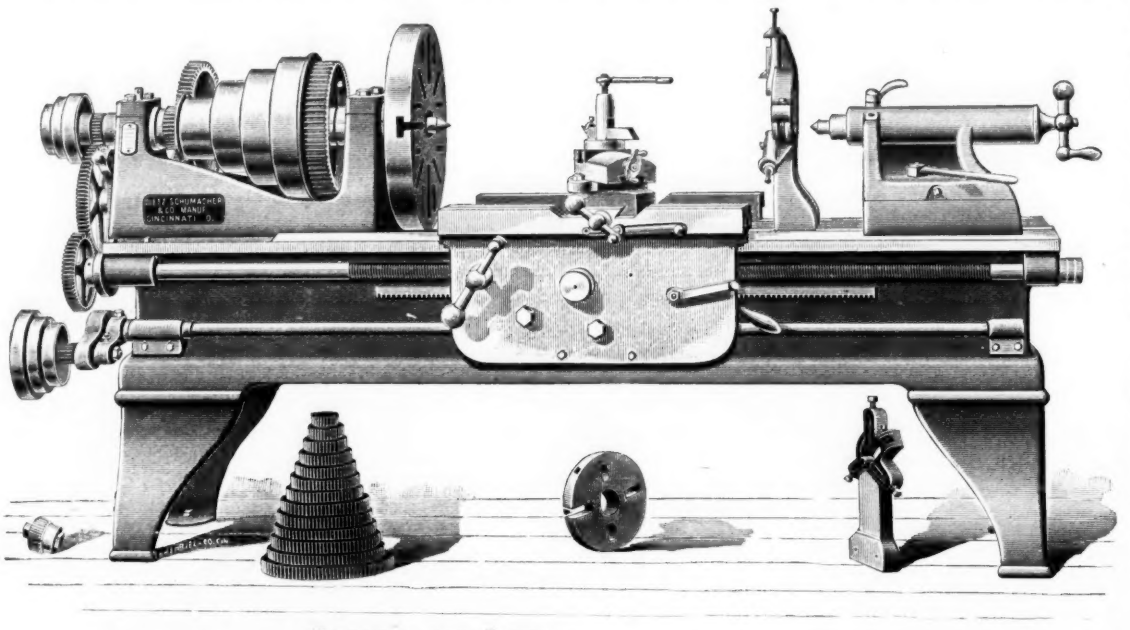
We illustrate herewith an eighteen-inch engine lathe which, as shown by the engraving, embodies all the features called for by modern practice, being very substantially proportioned, with ample driving power.

The front spindle bearing is $2\frac{1}{16}$" diameter, $4\frac{1}{16}$" long and the rear bearing 2" x $3\frac{3}{4}$". The spindle is of steel and has a $1\frac{1}{16}$" hole through it. Centers are No. 4 Morse taper.

The carriage is long and when the tool block is removed is flat upon top, making it convenient for fastening work to be bored or fixtures of any kind. There is automatic cross-feed, compound rest and an eccentric clamping device for holding the carriage during facing cuts. Friction and screw feeds cannot be thrown in at the same time, and the apron is secured to the carriage by planing a groove in the saddle into which the apron fits.

The lower feed cone is adjustable to regulate the tension of the belt.

The lathe swings over the carriage 10" and cuts threads from 3 to 20 per inch, including $11\frac{1}{2}$ pipe thread. It is made by Dietz, Schumacher & Co., Cincinnati, Ohio.



EIGHTEEN INCH LATHE.

Foundry Inventiveness.—II.

BY S. BOLLAND.

VERTICAL ELONGATIONS, PIPES, ETC.

Fig. 13 is intended to show how, by means of a short section of pattern, castings of increased length may be safely molded in the sand floor or within a containing flask. The figure represents part of the mold of a 24-inch pipe that is being made from a section of pattern 18 inches long. This short pattern is made to form both the mold proper and the core, by a gradual process of alternate drawing and ramming until the top or joint is reached, when the completed mold is to measure 5 feet in length.

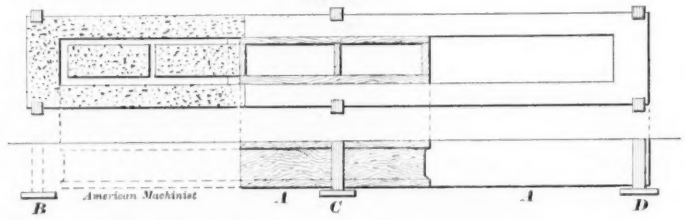
Whether the containing walls be a deep flask or curb, or a hole sunk in the floor, it is well, in almost all cases, to first make a hard joint at *A A*, over which to ram the cope; after which the hole may be sunk to the required depth at *B B;* straight-edges *C C*, can then be leveled, and their correct distance ascertained by measuring from the joint at *A*. The first ramming, from *B* to *D*, makes 18 inches of the pipe; by raising the pattern half its length, or 9 inches at a time, the ramming may be continued alternately without danger of forcing in the unsupported walls of the space below, until the whole is completed. As seen in the figure, the pattern has been rammed once to its full depth, once to 9 inches, and been again drawn, evenly all round, ready for ramming again.

Bottom flanges may be formed with sectional cores, set round the pattern before ramming commences, as seen at *E;* if desirable, top flanges may be formed in the green sand after the manner explained at Fig. 2. Branches may be located very readily at any part of the mold by means of the dry sand core device, shown at *F*, which, as seen, consists of upper and lower halves *G* and *H*, branch core *I*, and seating core *J*. These cores are all to be placed whilst the ramming is in process. After locating the branch, bottom half *H* is placed down in position, branch core *I* is set therein, clear of the pattern, and the upper half, *G*, set over. By leaving a space open behind the cores until the pattern has been drawn past branch core *I*, the latter can be easily thrust forward into the seating core *J*, which, besides centering the core, serves to hold it firmly in its place independent of chaplets. The space behind the branch core is then rammed hard, and all is complete.

FOUNDATIONS MACHINE BEDS, ETC.

Fig. 14 illustrates how a long machine or other bed may be molded from a section of pattern in the floor, as readily as in a pair of flasks. After the bed *A A* has been made to receive the pattern, mark off the position the latter must occupy on the bed, and from these lines as guide, set down foundation plates *B, C, D*, on either side. These plates may be divided, as seen, if a whole cope is employed; if more than one cope is used for covering with, a suitable disposition of the plates must be made. On these are built the supports for the cope or copes to rest upon as safely as upon the edge of a nowel part. When the cope stands within the pit, away from good staking ground, it is only necessary to have long, stout bars sunk in below the bottom, for stakes, and the arrangement is every whit as effective as the best bottom flask could possibly make it.

Fig. 14



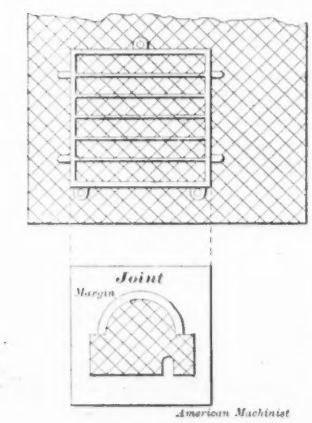


Fig. 15

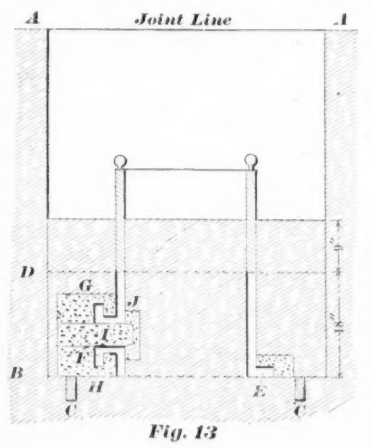


Fig. 13

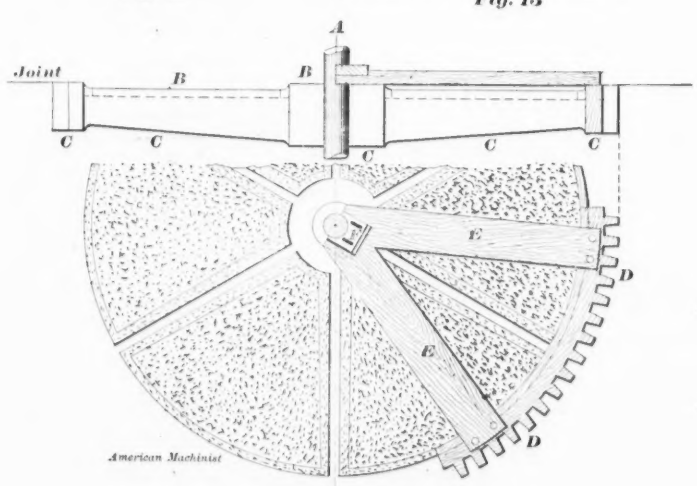


Fig. 16

FOUNDRY INVENTIVENESS.

DIAMOND FLOOR PLATES.

It will be seen at Fig. 15 how an order of floor plates, varying in size and shape from, perhaps, 2 to 6 feet square, may be made without mutilating the original pattern or being forced to use flasks large enough to contain the whole pattern, no matter how much smaller the desired casting may be, and when much smaller ones would serve the purpose. Suppose all the plates requiring the entire pattern are made, prepare a solid foundation on which to rest a full sized iron pattern, away from the molding floor; the plain side of the plates can then be made from the templates after the bed has been struck off, and the copes may be squared and rammed on some portion of the plate pattern, as shown. If a plain margin is wanted along the edge, the blackened cope will take up the impression of the whitened edge of the mold, and this will serve to mark off and finish the margin by.

GEAR WHEELS.

If the patternmaker and molder are equal to the occasion it is the least difficult piece of work imaginable to mold an ordinary gear wheel from a section comprising two arms and as much of the rim as is contained betwixt them, after the manner shown at Fig. 16. One important feature in making this piece of rim is to have it from $\frac{1}{8}$ to $\frac{1}{16}$ inch thinner than the finished mold must measure. This, whilst it does not materially affect the cores when it is being used as a part of the arm core box, is a decided advantage when the segment is transferred to the guide stay, as it is then just that much clear of the sand cores at the inner side. The process for molding this wheel is substantially as follows: By means of spindle *A* the surface corresponding to the top side of gear, and marked *B, B, B*, is swept all round, at the floor level, with sweep board No. 1. The impression of this surface is then taken in the cope, after which the hole is excavated some distance beyond the diameter of the wheel, and deep enough to form the whole bottom surface marked *C, C, C*, by means of spindle *A* and sweep-board No. 2. This surface corresponds to the hub, edges of the arms, and the bottom of the rim. The arm cores are now rammed in their respective places, as seen, after which the rim segment is loosened from the arms and attached to the guide stay *E E*. The segment, being brought back to its legitimate diameter at the pitch line, is consequently clear of the sand cores as previously observed. The iron plate *F*, at the spindle end of the guide stay, assists materially in a quick adjustment of the segment *D*, as by reason of the slot holes seen, the plate may be drawn towards or from the center with the greatest nicety and dispatch. After the segment *D* has been satisfactorily proved for the teeth, by actual trial, the teeth are rammmed all round, the spindle withdrawn, the center core introduced, the mold finished and closed.

FLY WHEELS.

There are more ways than one to mold a fly-wheel without a full pattern, and it is highly necessary that such should be the case, for what might be considered an excellent plan at one foundry would be impossible at others who are not so favorably circumstanced for handling them. The writer has made some very large ones,

whole and in halves, where the oven was large enough to hold all the mold, built upon a massive foundation, and the power sufficient to land the same from thence to the pit. When wheels can be made on a foundation, by this means, it is proper to strike first the bottom of the hub along with core beds at *A* and *B*, Fig. 17. The division of the arms being made by lines on the core beds the six sets of arm cores are duly placed thereon. The plan view at Fig. 17 shows all the cores in position except the one at *C*, where the bottom half only has been placed. The hub ends of the cores and covering plate *D* completes the

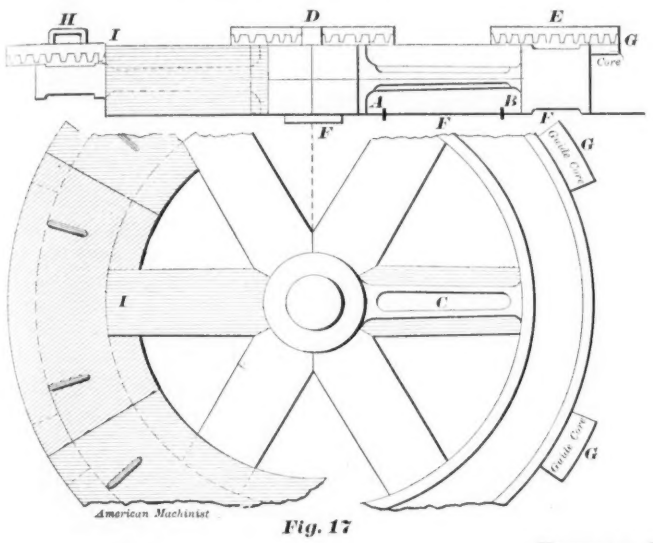


Fig. 17

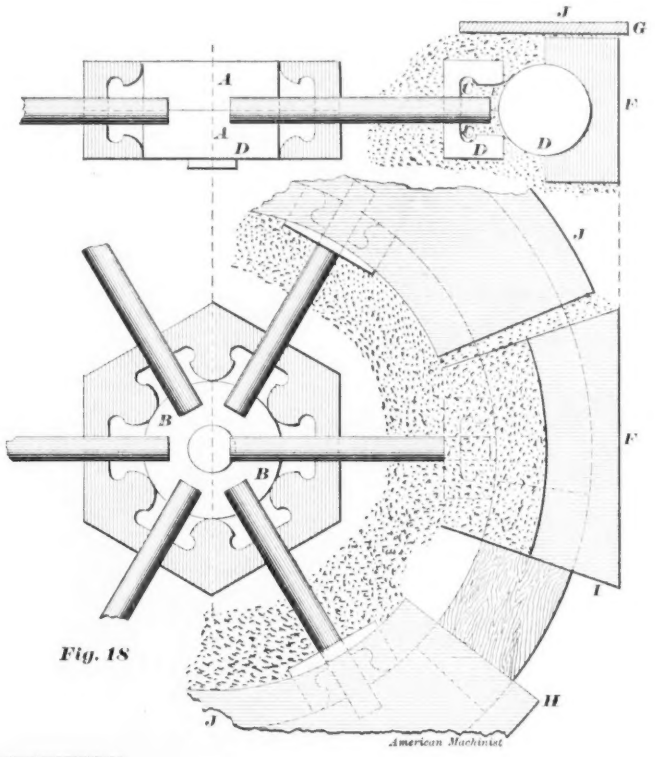


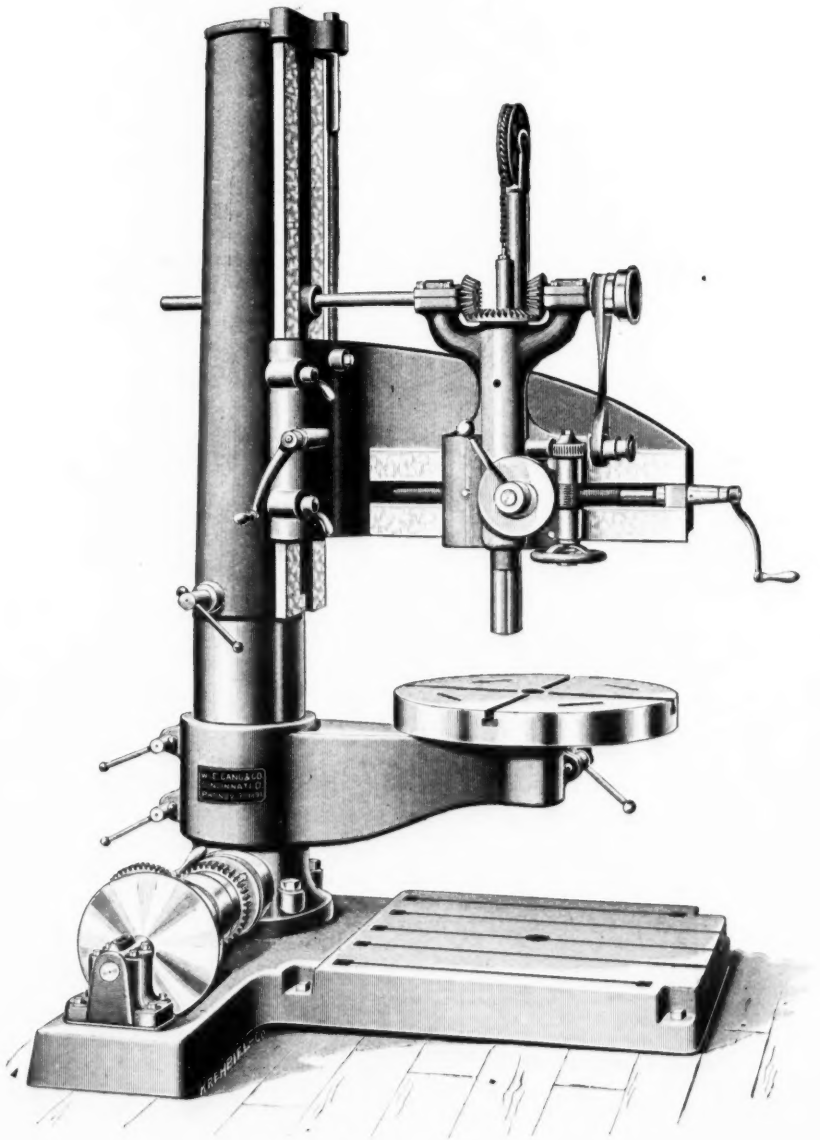
Fig. 18

FOUNDRY INVENTIVENESS.

hub, leaving the rim to be formed in bricks and loam by means of a sweep-board which reaches over the cores, from the spindle center, to that point. Covering plate, or plates, *E* completes the rim and makes it, on the whole, a very simple job.

Such a wheel, if made in the floor in green sand from a segment of the rim and day sand arm cores, would require the whole bottom bed at *F*, *F*, *F*, to be first swept off; particular attention being given to the rim and hub to have a sound mold surface there. After setting the arm cores the rim segment is rammed and withdrawn, consecutively, until the whole rim is formed. If plates similar to *E* were, in this case, used for covering with, it is well to set in guide cores at the joints, as shown; these guide cores to correspond in width to the outside guide edge struck all round the covering plates *E*. It will be found, in some instances, a much superior plan to first sweep a sand face on the floor corresponding to the whole upper surface, and after taking this impress in a suitable cope, proceed in the manner described to form the rest of the mold. The difference in molding a shallow and deep rimmed wheel is here explained. It will be seen that the cores at *E* can be made equal in depth to the rim, this is not so at *H*, where the rim is shallower. A consequence of this feature is that the covering plates require to be recessed at each core end, as seen at *I I*. Should the rim be deeper than is shown at *E*, as in a band wheel or pulley, the cores would be raised proportionately from the bottom and the rim ends would require to be built over. In sweeping a set of covering plates, like the ones illustrated, it is always best to set them round the spindle in their true relation to the wheel, and ram them with dry sand facing, with a finish of open skinning loam. After the surface has become set, a straight-edge and a sharp trowel serve to separate them without in any sense marring their shape. When due attention is given to this particular, as well as to the guide edges, it is possible to make the points of junction almost indiscernible. Smaller wheels may have covering plate in two halves; or perhaps whole, according to convenience. When the hub is required deeper than it is thought desirable to make the cores, a recess struck in the bottom bed and top covering plate will make the difference; the reverse of this will be necessary, if the hub must be shallower than the cores, that is, projections must enter at both ends.

Fig. 18 shows how to mold a fly wheel, the rim and hub of which are of cast-iron and the arms wrought-iron. It will be seen that the hub is composed of two halves of dry sand core, *A A*, corresponding to the form seen at *B B* in plan, whilst the rim ends of the arms are supported in six other cores, also made in halves, as seen at *C C*. The rim, as seen, is a round one, and may be easily molded by ramming a segment up entire, and drawing it along endwise, by successive stages, until the whole rim has been completed. The first process in this example is to prepare the hub and rim cores,



RADIAL DRILL.

after which, sweep the bottom surfaces marked *D*, *D*, *D*, taking care to prepare the hub and rim surfaces with facing sand, the rest will do old sand. If at least one-third of the rim be formed with the sweep it will be all the better. The bottom is now lined off in six equal divisions, and the lower halves of the cores placed in their respective positions. Place the arms so that they will not interfere with the rim segment as it is drawn past them, like the one shown at *E*. The upper halves of cores may now be pasted on, but be sure that the arms are all slack as they must be thrust forward, as seen in plan, after the rim is finished. The dry sand core, marked *F* in plan and elevation, is prepared beforehand, by means of the segment, and its inner edge corresponds in length, to a line drawn along the center of the whole segment. Before proceeding to ram, this core is set down in the position as seen, and the first ramming proceeds against segment and core alike, until the top is reached at *G G*, when the pattern, being slightly tapered, may be drawn some distance out and the operation repeated, until the space betwixt *H* and *I* will permit a portion of the pattern to extend within the mold at each side of the space, as shown by the dotted lines. The remaining space is now rammed to the top, and the core *F* lifted back; when the pattern may be pulled forward into the space previously occupied by the core, and then taken away. When core *F* has been returned to its place, and has been firmly fixed there by ramming behind, the covering plates, *J*, are bedded over, as seen. Sufficient weight is subsequently added to resist the upward pressure when the rim is poured. The rim in this instance is poured first, and as much time allowed to elapse, before the hub is cast, as will permit nearly all the shrinkage to take place.

Radial Drill.

We illustrate on this page what is called a combination radial and upright drill, from the fact that it combines some of the features usually found in both.

To the bed-plate is bolted a short column or stump over which the arm supporting the table is fitted, and this arm can be raised, lowered or swung about the column in the usual manner. Inside this short column is fitted the upper column which carries the radial arm. This column can be swung about to any desired position, and securely clamped in any position by a single motion. Thus, either the table or the radial arm may be swung entirely around the machine independently of each other.

The spindle is powerfully driven, has quick return motion and is counterbalanced.

The spindle feed screw and elevating screw are made of steel, and all thrust bearings are provided with phosphor bronze washers. The machine is made in three sizes, drilling to center of 3, 5 and 7-foot circles, respectively, receiving under spindles and upon bed-plate work 4 feet, 5 feet, and 5 feet 6 inches. Spindles have taper holes for Nos. 3 and 4 Morse shanks, and machines weigh 2,500 pounds, 3,500 pounds and 4,000 pounds. They are built by Wm. E. Gang & Co., 8-10 Harrison avenue, Cincinnati, O.

Paint for Machinery.

Mr. John Richards, in *Industries*, presents a little educational matter upon the subject of painting machinery. He says:

It is rather strained criticism to complain of the highly creditable display of machinery at the Midwinter Fair, on the grounds of "paint," but one must confess to disgust in seeing well-made machinery covered with glistening paint and varnish, showing every pin-hole and dentation of surface in the castings. The chromatic part, too, is execrable with but few exceptions. Think of cast-iron being painted with red ochre and varnished! Also, in some cases, with white lead ground in oil, relieved only by grease stains and landscape work on panels. It has long been conventional with makers of good machinery to paint it with lusterless paint of a color called steel, and as near to that of cast iron as possible. This causes the castings to look smooth, harmonizes with finished parts, and permits accurate photographing. We think that Manager Hunt should send for a barrel of "machine" paint, and insist on the exhibitors covering over the present ornamented and glistening surfaces.

Further, in respect to painting machinery, steel-colored lusterless paint and "filling," which is the same thing in a stiff paste, has by common consent become a sign of good taste and good work. Many years ago Messrs. William Sellers & Co., at Philadelphia, made experiments to determine how their machines could be properly photographed. All reflection had to be avoided. That was obvious, so the machines were lime-washed with different tints, which succeeded, but was a good deal of trouble because the wash had to be removed and substituted with paint. Mr. Tully, a paintmaker in Philadelphia, took up the

matter, and after a long train of experiments produced a lusterless paint that resisted animal oils, and with a good pigment lasted for years without change of shade. It also became as hard as iron and was applied to castings as soon as cleaned and before working them. The works in Philadelphia adopted this paint for machinery, and it has spread a good deal, but not so much as one could wish on this coast.

Best of its Kind.

A good many years ago, when church-organs were regarded with much disfavor by many pious and intelligent people, it was proposed to introduce one of these dangerous inventions into a New England meeting-house, one of the pillars of which was an old man of Quaker blood.

He was one of the most violent opponents to the plan when it was first proposed; in fact, he expressed his views so strongly that the person who was collecting money for the organ when it was at last decided to have it, did not venture to call upon the old Quaker for any subscription.

He met him on the street one day, however, and was agreeably surprised when the old man took out a substantial-looking wallet, and presented him with a most generous sum to add to his collection.

"Why," stammered the young man, "I—I am greatly obliged, sir, but I hardly thought you would care to be asked to contribute."

"My son," said the Quaker, with a suspicion of a twinkle in his serious eyes, "if thee *will* worship the Lord by machinery I would like thee to have a first-rate instrument."—*Youth's Companion.*

Improvement in Grinding Machine.

In our issues of May 24th and June 14th we described some recent additions and improvements made in a universal grinding machine built by The Appleton Manufacturing Company, Philadelphia. On this page we illustrate still other improvements.

Referring to the accompanying engravings, Fig. 1, shows the head and foot-stock as originally made; Fig. 3, the improvements, which are clearly indicated in the cuts, except that mention should be made that the foot stock is now provided with a spring center so as to allow for expansion of pieces of small diameter held between the centers. In Fig. 2 the machine is set for internal grinding, for which work the wheel head is turned end for end and the internal spindle belted to a flanged pulley placed in the position of the main emery wheel.

Style and Finish in Mechanical Work.

By A Mechanic.

It has not been very long since the practical side of the machinery question has come to receive proper attention. Mechanics have often been blamed for things they were not responsible for. A mechanic should not be blamed for the fashions of the world, over which he has no control.

I remember of talking with a carriage maker about using the bent braces about the iron work of sleighs and carriages, and while he admitted that they were in very bad form to resist pressure, and that it was a plain case of inconsistency from a mechanical point of view, he still insisted that such work was necessary, for his object in doing the work was to sell it, and, of course, what suited his customer, *must* suit him.

Mechanics have often been handicapped a great deal in this way, for the buyer is often not a mechanic, and so cannot admire mechanical beauty.

Mechanical beauty is a thing very different from what many people call artistic beauty. Mechanical beauty is a thing that appeals to animals of reason, where artistic beauty only pleases the eye. In my plain sight at this moment there stands a special machine, that to me is a thing of beauty. To some it would appear ugly, in fact, I should expect to see some people frightened at it, but it does not scare me. The material is placed where the strains come, and there is about the right amount of it, and it is in about the proper shape to resist the strains. There is not enough finish about it to suggest that such a thing had been attempted. It is black all over, and this, in my opinion, adds to its mechanical beauty.

I have noticed in the last few years a tendency on the part of machine builders not to plane and finish everything that can be well got at. Evidently many used to work on just this principle.

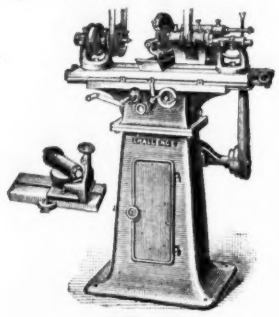


Fig. 1.

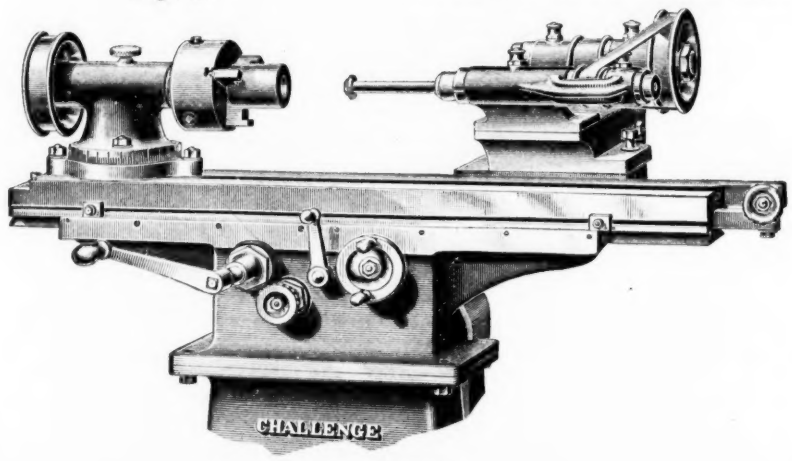


Fig. 2.

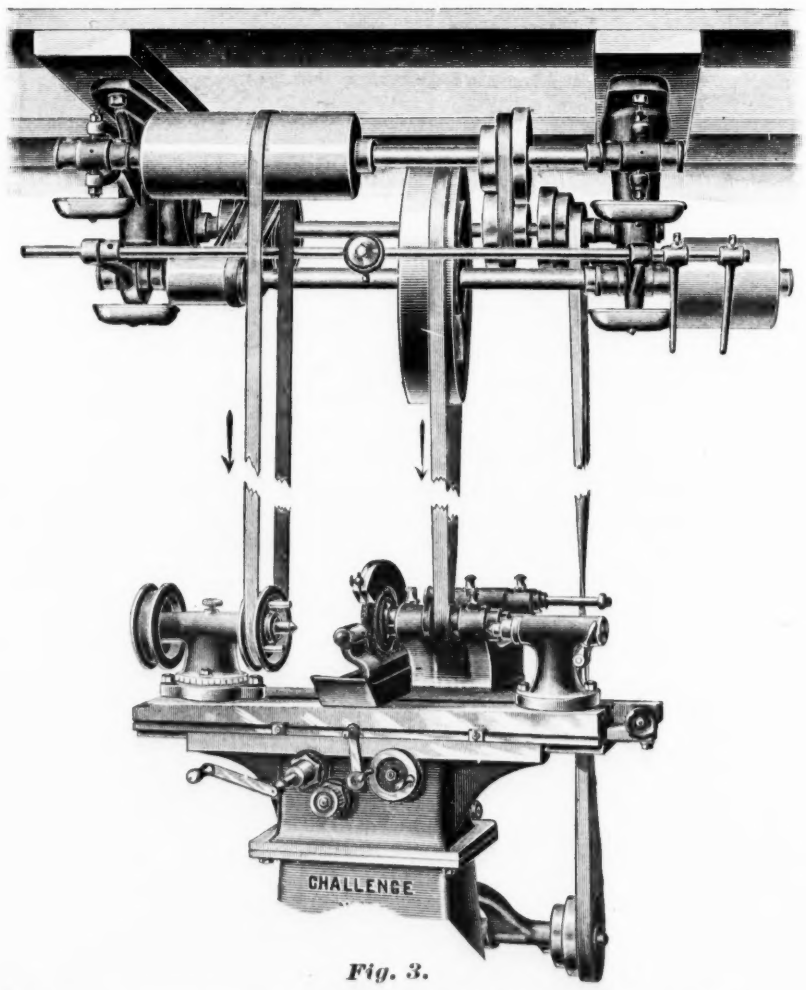


Fig. 3.

Mr. McGregor, in one of your late issues, mentions the non finish of lathe aprons. He might have said something about the non-finish, in the last few years, of each end of head-stocks, and one end of tail-stock, and many other places, that men a few years ago could not resist the temptation to finish, because they were so easy to get at. I should like to have the money at 25 cents per hour for all the time wasted in trying to keep these finished parts clean. Beyond a certain limit, it is a very serious loss to have machines highly finished. I do not mean the first cost of the work, so much as the continual cost of keeping the finished parts clean enough to look well. Machines that have been highly finished, fancy scraped and fancy stoned, are the worst appearing machines in the world when they become slightly dirty. An amount of dirt that will never make the slightest difference on a painted surface, looks very bad on a highly finished surface.

I remember while working in a jobbing shop in Bangor, Me., there was work being done for a doctor who, it struck me, had rare mechanical sense for any one not a mechanic. He was having a steamboat built, the engines for which were being built in Boston. I overheard him telling the foreman that for his engines he had ordered that all the expense usually put into finish be put into quality. I don't know whether he got what he ordered or not, but he certainly should have got it. There are machinists who have become so accustomed to combine finish with good work, that if you ask them to leave out the finish they are apt to leave out the good work also. This ought not to be. There is just as much difference between quality and finish in a machine as there is between something good to eat and something that is only an imitation of it. Hard common sense is what the mechanical world wants to-day in machinery, and do not forget to harden some of the parts of this hard-headed machine, even if it is not made to glisten.

I have seen machines made with great care, and very great care as regards finish, but for the want of a very little matter their lives of usefulness were reduced fully ten times. To be plain, all screw heads were left soft, and all wrenches furnished with the machines were left soft to match. This is what I call a soft-headed machine. The result is that the screw heads soon become quite round, and the wrenches seem to turn around on them, and then the workman get's it into his head that the machine is only an old "rattle trap," and that a hammer is good enough to use for a wrench. In this case the machine does become a "rattle trap" in short order.

Now to show the contrast: Not more than 15 feet from one of these soft-headed machines there stood a machine of about the same kind and age, but it was a hard-headed machine and the wrenches were also hardened. When new the soft-headed machine looked much better than the other, and I believe in many respects it was superior, but after three years I would give twice as much for the hard-headed machine. This is not a fancy sketch, but from real life. It is one thing to give a machine a good appearance long enough to sell it, and quite another to make it keep the good appearance for years, and so make men respect it, and not use it for a chopping block. As far as styles or fancies are concerned I believe they will change to suit a machine if it is stuck to long enough. The first bicycles with large front wheel were thought to be fine-looking machines, but fancies have changed, so now people think they are something to laugh at. The Star bicycle was called a homely machine with its straight line frame, but it was far ahead of the other in mechanical beauty. When the first low-wheeled machines came out there were attempts at crooked framing, but they had to give away to a straight-line frame of the diamond pattern in order to get the least weight, and, now, as the eye of fancy has become accustomed to them, no one says they are homely. I believe that *right* in mechanical things, is about the same as in anything else, and that seems to be that *right*, in the end, is always ahead. Everything in machinery requires special and careful thought, and should not be as in in law, based upon the work of predecessors.

The first horizontal steam engines were made with wooden beds, which were built same as other wooden things with more regard for convenience in building than anything else. Now, the first man who constructed a bed of iron must have been something of a lawyer, for he followed his predecessor's mistakes, and the world had to wait for Mr. Corliss to make the correction.

Style, or fancy, should not stand in the way of good common sense, but it often does, and is often the greatest obstacle that common sense has to contend with. Bessemer steel has become so cheap as a building material that there is now no great reason why it should not be used more, except that the old customs are hard to root out. Men will brace up and use a little of it, but when it comes to finish some must have hard pine, or what is sometimes called *pitch pine*. Every one knows that "pitch pine" is just the stuff to build a fire with. Every one also knows, or should know, that furnaces are built considerably after the fashion of some (so called) fire-proof buildings, and that when you load one of these "fire-proof" furnaces with "pitch pine" and set it on fire, it is apt to burn first rate, but it seems it will take 50 years to call attention to this matter, and in the meantime the insurance companies are growing fat and saucy. I believe the use of wood or other inflammable material can be avoided in the construction of buildings if the matter is only given proper attention, and some of the ancient fancies are dumped overboard.

Prose Will Not Do.

That the request of the Cramps for a chance to bid upon the construction of British naval vessels, is considerably exercising the British mind, is abundantly shown by their treatment of it in England. Ordinary prose seems indequate to express

their feelings, and *Fairplay*, of London, inflicts upon its readers the following:

YANKEE-DOODLEISM.

BY OUR KENTUCKY POET.

Say, Britishers, look here; ain't you feeling rather queer?
Guess you'll see some ships worth looking at ere long;
You will find them rather tough, you're going to have it rough,
For beside them your old "tubs" ain't worth a song.
With the Louis and St. Paul we will open out the ball;
We intend to lick creation, that we do;
So, Britishers look out, or you'll all be up the spout,
When we bring our "record breakers" on the blue.

Chorus.

Cramp, Cramp, Cramp, the boys are singing;
Cramp's the only builder up to date;
If you want a proper ship, on the herring-pond to rip,
Cramp's the man that flyer to create.

I guess they'll make you stare, and raise on end your hair,
When you see our "sainted" crackers steam ahead.
For the ocean it is wide, and to douse the British pride,
All our Yankee-doodle bunting we will spread.
You have gone it rather fast, but we've caught you up at last;
You will find that two at hide-and-seek can play;
With our Philadelphia crew, every one a "doodle do,"
We've come at last and here we mean to stay.

Chorus.—Cramp, Cramp, Cramp, etc.

Yes, I guess we mean to stay, and play our little play,
While the stars and stripes are floating in the sky;
From the keel right to the truck you will find no British muck,
And we are going to have our innings by-and-bye.
The time it soon will come when you'll pay a princely sum
To get our Cramps to build a proper ship;
A ship of nickel-steel, oh! how nice 'twill be to feel
That we've got the British lion on the hip.

Chorus.—Cramp, Cramp, Cramp, etc.

This is full of English instead of American idiom, but no doubt many Englishmen will always believe it really emanated from a Kentuckian, and the editor of *Fairplay* would do well to keep away from Kentucky. They are awfully sensitive down there, and carry hair-trigger guns.

Plates of Uniform Strength.

BY ALBERT E. GUY.

SECTION 1.

A circular plate of radius R is encastré, or fixed at the edge, and supports a load P at its center.

It is customary in practice to solve the problem of the uniformity of resistance of beams to the direct stresses due to bending, to neglect the shearing action of the load, in order to simplify the calculations. If necessary, special consideration is given to the shearing stresses afterwards, and the dimensions of the beam may then be altered to suit the conclusions arrived at.

Let us now consider in Fig. 1 a beam $A\ B\ C$ of rectangular section (b h) supporting at its free end a load P.

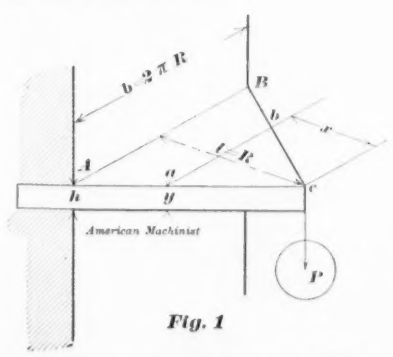


Fig. 1

The bending moment for the section at $A\ B$ is $P\,l$, and for any section $a\ b$ it equals $P\,x$.

The well-known equation:

(1) $P\,l = f\frac{I}{a} = f\frac{b\,h^2}{6}$ (for a rectangular section), permits us to determine the dimensions of the beam.

$\frac{I}{a} = \frac{b\,h^2}{6}$ is the modulus of section of the beam.

f represents the working stress suitable for the material, and, in our case, since the plate must be of uniform strength f is constant for any section.

We may express b in function of l and write $b = n\,l$.

The value of n agreed upon becomes a constant, and the thickness $h = \pm\sqrt{\frac{6\,P\,l}{f\,n\,l}}$

$$= \pm\sqrt{\frac{6\,P}{f\,n}} = \text{constant}.$$

In a beam thus shaped, the section being rectangular, the thickness h is uniform, and the beam is of uniform strength.

In effect for a section $a\ b$ the bending moment is $P\,x = f\frac{b_1\,h_1^2}{6}$.

But $b_1 = n\,x$, hence $h_1 = \pm\sqrt{\frac{6\,P\,x}{f\,n\,x}}$

$$= \pm\sqrt{\frac{6\,P}{f\,n}} = h.$$

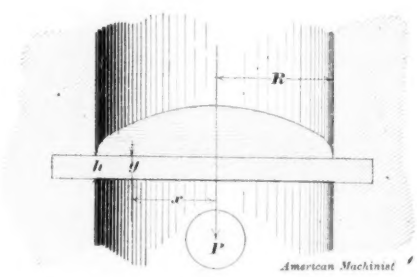


Fig. 2

If we make $l = R$ and $A\ B = b = 2\,\pi\,R$, then n is equal to $2\,\pi$. But $2\,\pi\,R$ represents a circumference of radius R (Fig. 2). It is but logical, then, to consider the case of a circular plate encastré, or fixed at the edge, and supporting a weight P at its center, as being similar to that of a beam $A\ B\ C$, of length $l = R$, supporting an equal weight P at its free end, and having at $A\ B$ a dimension $b = 2\,\pi\,R$. The thickness for both cases $= h$.

Formula (1) becomes

$$P\,R = f\frac{2\,\pi\,R\,h^2}{6}.$$

(2) And $h = \pm\sqrt{\frac{3}{\pi}\cdot\frac{P}{f}} = \text{constant}$

$$= \pm\,0.977\sqrt{\frac{P}{f}}.$$

The thickness h is then entirely independent of the radius of the plate.

This formula (2) does not express the stress due to the weight of the plate, but in paragraph 3 we will determine formulæ to that effect.

It is, of course, impossible to suspend or apply any weight at the very center of this circular plate; provision must be made for a convenient support to prevent the punching or shearing of the plate at the line of application of the load.

(3) The stress $f = \frac{3}{\pi}\cdot\frac{P}{h^2} = 0.954\,\frac{P}{h^2}$.

(4) And the load $P = \frac{\pi}{3}\,f h^2 = 1.047\,f h^2$

If a prismatic body $M\ N$, Fig. 3, be subjected to bending by a force P, any section $m\ n$ is subjected at points m to extension, and n to compression, due to the bending effort. Apart from that, the portion of the body at the right of $m\ n$ tends to slide by that at the left, in a direction perpendicular to the axis of the body, that is the shearing effort. The two stresses being at right angle to each other, their resultant is the diagonal of a rectangle.

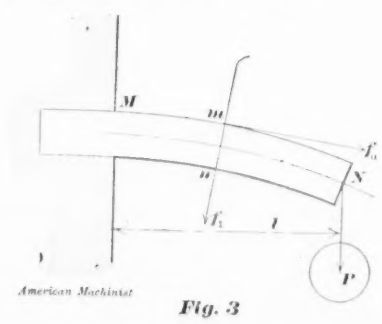


Fig. 3

Naming f_0 the tension due to bending, and f_1 the resistance to shearing, the resultant of these two =

(5) $T = \pm\sqrt{f_0^2 + f_1^2}$.

But $f_0 = f = \frac{3}{\pi}\cdot\frac{P}{h^2}$ for any point along radius R (Fig. 2), and $f_0^2 = \frac{9\,P^2}{\pi^2\,h^4}$.

The value of f_1, for any radius x, is,

$$f_1 = \frac{P}{b\,h} = \frac{P}{2\,\pi\,x\,h}.$$

$$f_1^2 = \frac{P^2}{4\,\pi^2\,x^2\,h^2},$$

and finally,

(6) $$T = \pm\sqrt{\frac{9\,P^2}{\pi^2\,h^4} + \frac{P^2}{4\,\pi^2\,x^2\,h^2}},$$

$$T^2 = \frac{4\times 9\,P^2\,x^2}{4\,\pi^2\,h^4\,x^2} + \frac{P^2\,h^2}{4\,\pi^2\,x^2\,h^4}.$$

Let us make $a = 4\,\pi^2\,x^2\,T^2$.

(7) Then $a\,h^4 = 36\,P^2\,x^2 + P^2\,h^2$.

$$h^4 - \frac{P^2\,h^2}{a} = \frac{36\,P^2\,x^2}{a}.$$

$$h^2 - \frac{P^2}{2\,a} = \pm\sqrt{\frac{36\,P^2\,x^2}{a} + \left(\frac{P^2}{2\,a}\right)^2}$$

$$= \pm\sqrt{\frac{36\,P\,x^2}{a} + \frac{P^4}{4\,a^2}}.$$

(8) and h

$$= \pm\sqrt{\frac{P^2}{2\,a} \pm \sqrt{\frac{36\,P^2\,x^2}{a} + \frac{P^4}{4\,a^2}}}.$$

Fixing a value for coefficient T, this last equation will express the thickness of the plate at any distance x from the center.

Formulæ (2), (3) and (4) will suffice in the ordinary cases of practice, but when P is very great, then formula (8) should be used.

The deflection of the plate can be determined by the general equation,

(9) $$\frac{d^2\,y}{d\,x^2} = \frac{M_0\,a_0}{I_0\,E\,a_x}.$$

M_0 = bending moment $= P\,R$.

$a_0 = \frac{h}{2}$ along a circumference of radius R.

$a_x = \frac{h_1}{2}$ along a circumference of radius x.

I_0 = moment of inertia of section $= \frac{b\,h^3}{12}$

$$= \frac{2\,\pi\,R\,h^3}{12} = \frac{\pi\,R\,h^3}{6}.$$

E = modulus of elasticity of the material. When $a_0 = a_x$, or when the thickness is uniform, the elastic line is an arc of circle.

We will not here establish the formulæ relating to the deflection of circular plates, but we will make it the object of a special chapter. This question although very interesting for the student is in reality of secondary importance in practice, and we can afford to neglect it at first, the intention being to simplify the subject as much as possible.

SECTION 2.

A circular plate of radius R is encastré, or fixed at the edge, and supports a load p per unit of area, Fig. 4.

The total load upon the plate is

(10) $$P = \pi\,R^2\,p.$$

If this total load P was distributed along a circumference of radius r, so as to produce a bending moment $P\,(R - r)$ at the edge equal to that due to the load p uniformly distributed, this radius r would be found as follows:

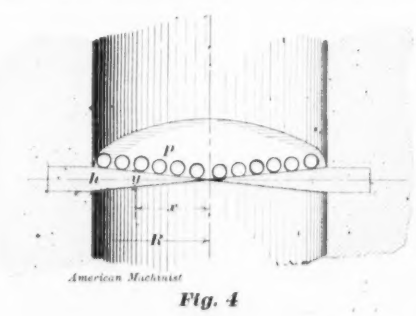


Fig. 4

(11) $$\frac{P}{2} = \frac{\pi\,R^2\,p}{2} = \pi\,r^2\,p,$$

whence $$\frac{R^2}{2} = r^2,$$

(12) and $r = \pm\sqrt{\frac{R^2}{2}} = \frac{R}{\sqrt{2}} = \frac{R\sqrt{2}}{2} = 0.7071\,R.$

In other words, r is the radius of a circle whose area $= \frac{1}{2}$ that of the disk of radius R.

The bending moment $M = P\,(R - r) =$

(13) $P\,(R - 0.7071\,R) = P \times 0.2929\,R$, and a weight P_1 applied at the center of the plate whose moment $M = P \times 0.2929\,R = P_1\,R$, would be

(14) $$P_1 = \frac{P \times 0.2929\,R}{R} = 0.2929\,P.$$

Equation (1) paragraph 1: $P\,l = f\frac{b\,h^2}{6}$, becomes:

(15) $$0.2929\,P\,R = f\frac{b\,h^2}{6}\,f = \frac{2\,\pi\,R^2\,h^2}{6}$$

$$= f\frac{\pi}{3}\,R\,h^2.$$

But $P = \pi\,R^2\,p$ (10).

(16) hence $0.2929\,P\,R = 0.2929\,(\pi\,R^2\,p)\,R$

$$= f\frac{\pi}{3}\,R\,h^2.$$

From which we deduce

$$h^2 = \frac{0.2929 \times 3\,R^2\,p}{f},$$

(17) and finally $h = \pm\sqrt{\frac{0.8787\,p\,R^2}{f}}$

$$= \pm\,0.938\,R\sqrt{\frac{p}{f}},$$

h is the thickness of the plate along a circumference of radius R. The very fact that h varies directly as R, indicates that the thickness cannot be uniform radially.

If we want to determine the value of $h_1 = y$ for any radius x, we remark that the plate of area $\pi\,x^2$ and radius x may be considered as encastre, or fixed, at its circumference, and loaded with a weight p per unit of area.

The bending moment is then $M_1 = P_1{}^1\,x$

$$= f\frac{2\,\pi\,x\,y^2}{6},$$

$$P_1{}^1 = 0.2929\,(\pi\,x^2\,p),$$

$$M_1 = 0.2929\,(\pi\,x^2\,p)\,x = f\cdot\frac{\pi}{3}\,x\,y^2,$$

$$\frac{0.2929 \times 3\,x^2\,p}{f} = y^2,$$

(18) and $y = \pm\sqrt{\frac{0.8787\,p\,x^2}{f}}$

$$= \pm\,0.938\,x\sqrt{\frac{p}{f}}.$$

But when $x = o$, $y = o$.

In other words, at the center $h = y = o$, and $p = o$; and along the radius R the thickness varies from o to $\pm\,0.938\,R\sqrt{\frac{p}{f}}$.

(19) The stress $f = \frac{0.8787\,p\,R^2}{h^2}$

$$= \frac{0.8787\,p\,x^2}{y^2},$$

and the load

(20) $$p = \frac{f\,h^2}{0.8787\,R^2} = \frac{1.138\,f\,h^2}{R^2}$$

$$= \frac{1.138\,f\,y^2}{x^2}.$$

In practice it will suffice to determine the thickness h of the edge of the plate, and join the extremities of the line representing this thickness on the drawing to the center with two straight lines, as shown in Fig. 4, to indicate the variation of h radially. For Equation (18): $y = 0.938\,x\sqrt{\frac{p}{f}}$, is that of a straight line, since $\sqrt{\frac{p}{f}} = \text{constant}$.

It is well understood that provision must be made for meeting the requirements of the material used and the kind of loading to which the plate may be subjected. The thickness found by the above formulæ may have to be modified, and should certainly be so around the center when the plate is subjected to steam, gas or fluid pressure so as to allow for the porosity or the uneven shrinkage of the material when cooling in the mold; but the dimensions first found should never be reduced in making allowance for uneven strains in the plate.

The bending stress f_0 combines with the shearing stress f_1, as in paragraph 1, and the resultant tension:

$$T = \pm\sqrt{f_0^2 + f_1^2}.$$

(20) $$f_0 = f = \frac{0.8787\,p\,x^2}{y^2}.$$

$$f^2 = \frac{0.771\,x^4\,p^2}{y^4}.$$

The shearing stress:

$$(21)\qquad f_1 = \frac{\pi x^2 p}{b\,h} = \frac{\pi x^2 p}{2\pi x y} = \frac{p\,x}{2\,y}.$$

$$f_1^2 = \frac{p^2 x^2}{4\,y^2}.$$

$$(22)\qquad T^2 = \frac{0.771\,x^4 p^2}{y^2} + \frac{p^2 x^2}{4\,y^2}.$$

$$y^4 = \frac{0.771\,x^4 p^2}{T^2} + \frac{p^2 x^2 y^2}{4\,T^2}.$$

$$y^4 - \frac{p^2 x^2 y^2}{4\,T^2} + \left(\frac{p^2 x^2}{8\,T^2}\right)^2 = \frac{0.771\,x^4 p^2}{T^2} + \left(\frac{p^2 x^2}{8\,T^2}\right)^2$$

$$y^2 - \frac{p^2 x^2}{8\,T^2} = \pm\sqrt{\frac{0.771\,x^4 p^2}{T^2} + \frac{p^4 x^4}{64\,T^4}}.$$

$$y = \pm\sqrt{\frac{p^2 x^2}{8\,T^2}} \pm \sqrt{\frac{0.771\,x^4 p^2}{T^2} + \frac{p^4 x^4}{64\,T^4}}$$

and finally we have:

$$(23)\qquad h_1 = y = \pm x\sqrt{\frac{p^2}{8\,T^2}} \pm \sqrt{\frac{0.771\,p^2}{T^2} + \frac{p^4}{64\,T^4}}.$$

p must never equal the value of T, for the elasticity of the material would then be impaired.

The only formulæ now in use, relating to the strength of circular plates, are those established by Grashof, and they, for the present case, are as follows:

the thickness $h^2 = \frac{3}{4}\cdot\frac{m^2-1}{m^2}\cdot R^2\cdot\frac{p}{f}$;

from this equation, the load p and stress f are deduced, viz.:

$$\frac{h^2 f}{R^2}\cdot\frac{m^2}{m^2-1}\cdot\frac{4}{3} = p$$

$$\frac{3}{4}\cdot\frac{m^2-1}{m^2}\cdot R^2\cdot\frac{p}{h^2} = f.$$

The thickness here is understood to be uniform radially, for no mention is made by Grashof of the possibility of it to vary with the radius.

m is a coefficient variable with the material used, and but few experiments have been made to determine its value.

Rankine makes $m = \infty$, in which case:

$$\frac{m^2-1}{m^2} = 1.$$

Grashof advises to make $m = 3$.

Then $\frac{3}{4}\cdot\frac{m^2-1}{m^2} = \frac{3}{4}\cdot\frac{3^2-1}{3^2} = \frac{2}{3}$.

We may say that $\frac{m^2-1}{m^2}$ varies from o, when $m = 1$, to 1 when $m = \infty$.

If we compare the maximum value of h in our formula (17)

$$h = \pm 0.938\,R\sqrt{\frac{p}{f}},$$

with that expressed by Grashof:

$$h = \pm\sqrt{\left(\frac{m^2-1}{m^2}\right)\frac{3}{4}\cdot R^2\cdot\frac{p}{f}}$$

$$= \pm R\sqrt{\frac{2}{3}\cdot\frac{p}{f}} = \pm 0.816\,R\sqrt{\frac{p}{f}},$$

and that deduced from Rankine's value of m,

$$h = \pm R\sqrt{\frac{p}{f}\cdot\frac{3}{4}} = \pm 0.866\,R\sqrt{\frac{p}{f}}$$

the following table will show the relation between the three expressions:

$h = \pm c\,R\sqrt{\frac{p}{f}}$.

$c =$	Grashof.	Rankine.	Equation (17).
	0.816	0.866	0.938
	1.	1.061	1.149
	0.942	1.	1.083
	0.869	0.923	1.

We may remark that our coefficient: 0.938, has been logically deduced, whereas a value of m had to be guessed at by the two cited authors. The following paragraphs will show the correctness of our method, principally so in the case of ribbed plates.

It might be of interest to compare also the strength of the plate treated in paragraph 1 with that treated here.

Equation (4) § 1, expresses the load.

$$P = \frac{\pi}{3} f h^2 = 1.047\,f h^2$$

and equation (20) $p = \frac{f h^2}{0.8787\,R^2}$.

The total load uniformly distributed $= \pi R^2 p$.

We may then write:

$$\pi R^2 p = \frac{f h^2 \pi}{0.8787}, \text{ and } \frac{\pi R^2 p}{P} = \frac{\frac{f h^2 \pi}{0.8787}}{\frac{\pi}{3} f h^2} = \frac{3}{0.8787} = 3.414.$$

In other words, the plate uniformly loaded will support a weight 3.414 greater than the plate loaded at center.

SECTION 3.

A circular plate of radius R is encastré, or fixed, at the edge and supports a load p per unit of area, and a weight P at its center, Fig. 5.

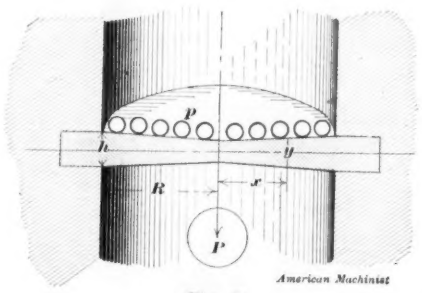


Fig. 5

The total load uniformly distributed $= P_1 = \pi R^2 p$.

The moment due to that load = (see equation 15.)

$M_1 = P_1 \times 0.2929\,R = 0.2929\,P_1\,R$.

The moment due to weight $P = M_2 = P\,R$.

The total moment $M = M_1 + M_2$.

$$(24)\qquad M = 0.2929\,P_1\,R + P\,R = f\frac{b\,h^2}{6}.$$

Substituting the values of $P_1 = \pi R^2 p$ and of $b = 2\pi R$, we have:

$$(25)\quad 0.2929\,\pi R^2 p\,R + P\,R = f\frac{2\pi R h^2}{6}.$$

$$3 \times 0.2929\,\pi R^2 p + 3P = f\pi h^2.$$

$$(26)\quad \text{Thickness } h = \pm\sqrt{\frac{0.8787\,R^2 p + 0.954\,P}{f}}.$$

For given load p, tension f and thickness h,

$$(27)\qquad \text{load } P = \frac{f h^2 - 0.8787\,R^2 p}{0.955}.$$

$$(28)\quad \text{Tension } f = \frac{0.8787\,R^2 p + 0.954\,P}{h^2}.$$

Equation (26) expresses the thickness h along a circumference of radius R. But this thickness is not uniform radially. It could be demonstrated by considerations similar to those employed in the preceding paragraph, that at the center

$$h_1 = y = \pm\sqrt{0.954\frac{P}{f}};$$

and for any radius x,

$$(29)\quad h_1 = y = \pm\sqrt{\frac{0.8787\,x^2 p + 0.955\,P}{f}}.$$

for at center $p = o$, and $x = o$.

When a plate of large radius supports a load P at its center, it may be necessary to consider the moment due to its own weight. Elaborate calculations would give us an exact formula answering this case, but a simple approximation will, in most instances, be found sufficient. The plate may at first be figured out as in paragraph 1, then the weight of it will be approximated rather more than less, and the moment due to the load p per unit of area thus found will be added to that produced by load P.

Formula (29) will express the thickness $h_1 = y$ for any radius x.

"E. D.," "X Y.," "A Subscriber," "X.," and numerous others who have made inquiries of us anonymously, are hereby notified that their anonymous communications have gone into the waste basket, in accordance with our invariable rule. If the inquiries are repeated, and full name and address given, they will receive attention. We have our hands full in attending to the correspondence of people who make themselves known to us.

An exchange speaks of machine surfaces "superficially polished." This, we suppose, is to distinguish them from a surface-polished but not on the surface.

The quantity of paint required to give the new Forth Bridge three coats is estimated at ninety tons.

LETTERS FROM PRACTICAL MEN.

Finding Odd Divisions by Scale—Fluting Reamers.

Editor American Machinist:

Sometimes in sizing gear blanks odd divisions are required which are not usually found on the regular machinist scales. In such cases the fraction can be reduced to a decimal and measured by an ordinary scale.

For example, required to set calipers to measure the diameter of a gear blank of 21 teeth 7 pitch.

The outside diameter is $3\frac{3}{7}$ inches. $\frac{3}{7}$ inch $= 2 \div 7 = .285$ inch. $\frac{9}{32}$ inch $= .281$ inch. Then set calipers to $3\frac{9}{32}$ inches, and they are but .004 inch under size, which is near enough for practical purposes.

I have sometimes found it necessary to make a reamer without the usual facilities for fluting it. I divide the number of teeth in the cone gear of lathe by the number of flutes required, place chalk marks around it, corresponding to the number of divisions required, and also one chalk mark on the mating gear. I then take a common side tool, grind it to the proper angle, set the top edge radial from the center, and flute the reamer, making a first class job in every respect.

J. T. G.

Balancing Pulleys—Tool Rooms.

Editor American Machinist:

I am certainly at variance with the "Old Boy." He makes things gravitate downward a good deal slower than I do. This is shown by our figures on the problem in physics, presented by Mr. Allen. It is not my purpose to discuss this subject, preferring to leave that to those better qualified, but will say that my figures are not likely to be exact, because my data was partially derived from experiments, which, doubtless, were wanting in precision. When I found that the bar, when swung by the thin end, made 72 vibrations per minute, it was an easy matter to determine the length of time it would consume in falling through one third of its vertical movement, which is 12 inches, when started from a point horizontal to its axis; the length of the bar being 36 inches. I mention this that my method may be clearly understood. I would be glad if your contributor, "An Old Boy," would point out my mistake, if one has been made.

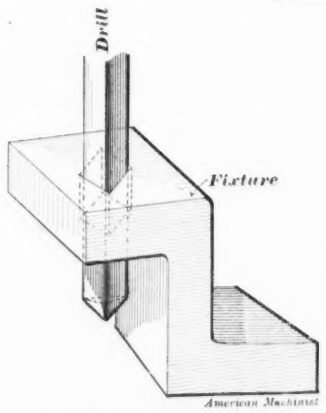
I would like to say a word about pulleys, and the way they are balanced; especially those having wide faces, proportional to their diameters. I never could see the propriety of going to expense in patterns and flasks for such pulleys, when two narrower ones, placed side by side, make as good, if not a better job. Take, for example, a pulley 20 inches diameter and 24 inches wide, such as are often used as tighteners. I recently had some experience with one of these which had been put in standing balance, but when run was found to be out of balance at both ends and at opposite sides, so much so that something had to be done to remedy the trouble. There was a counterweight at each side; one having about double the weight of the other. I discovered by examining the thickness of the two rims, that the lighter weight had been placed where the heavier one should have been. By detaching these and reversing them, the difficulty was entirely overcome. If this pulley had been formed of two, and each balanced separately, there would have been no trouble.

I see one of your readers is desirous of having the subject of tool rooms brought up. Permit me to offer a few thoughts on this. I don't think any machine shop, however small, can afford to be without some kind of a tool room. One of the principal difficulties, I think, in making a success out of such a department, lies in not being able to adopt a system suited to the size and wants of the shop. It is clear that in large shops this becomes a very important feature, and its advantages are marked. Proprietors and managers of smaller works often take their cue from these larger ones, and attempt to imitate them. Such efforts are apt to fail. I have seen an elaborate room thus fitted up, and all the loose tools, good, bad and worthless, which, for years, had been collecting about the shop, stowed into it. A school-boy, spending his vacation, is put in charge to receive and hand out tools. A boy that, perhaps, did not know a milling cutter from a mandrel. Is it any wonder that such efforts should fail?

The fact is, that one of the best men in the shop should be put in charge of the tool room. Of course, he cannot be expected to put in his whole time in looking after the tools, especially when the shop is small. A lathe, or some other machine, may be located near the tools, and employment found on general work, when the tools are not demanding attention. Nor need he be troubled with passing tools over a counter, for where but few men are employed, they may be depended on to find and replace such tools as they may want. This reduces the tool room to about its simplest form, and yet one that may be made very efficient.

One of the greatest drawbacks to anything of this kind comes when the most prominent characteristic in the foreman is a lack of system and order. If this is wanting, no printed rules and regulations, although emanating from his superiors, will avail anything. Nor can the services of inferiors supply it. At a time of dearth in business, something resembling order may be attempted, but when the hurry comes, all goes to pieces. The semblance of a tool room, if they have one, is neglected or abandoned, and the men begin to hide away such tools as they think they may want, and by this, things are duplicated over and over by persons who are unable to find the thing they want. Or, perhaps, as much time is spent in hunting for mislaid tools as would be consumed in making them. But I must not forget that the advantages to be derived from a tool room are so apparent, and so well known, that it is needlessly consuming time and valuable space to speak of them. I would say, in conclusion, to those who have never attempted to collect shop tools together, that if they can do no more, provide a bench or large table, locate it in some light and convenient place—not in a dark out-of-the-way corner—and require every man and boy, when he is done using a tool, to place it, cleanly wiped off, on this table. This may be regarded as the first step, in the establishment of a tool room, and if followed up, is likely to result in a system which will not be spoiled by red tape, or broken down by unnecessary expense.

"QUIRK."



Drilling Square Holes.

Editor American Machinist:

It is, perhaps, not commonly known how to drill a square hole, but it is a thing that can very easily be done.

Make the drill of a three-sided steel bar, which side is like the side of the square hole you want, and prepare it in the end for cutting good and freely. Over the spot where the hole is wanted place a fixture with a square hole of same size as required. The drill can be fixed for a boring machine, and is guided in the hole of the fixture. The finished holes look good with slightly rounded corners.

C. O.

Measuring Pitch of Screw.

Editor American Machinist:

I recently had occasion to measure the pitch of a fine thread screw on a microscope objective, in order to cut a thread on the

end of a tube to take the same. The means I took to do this, although very simple, and involving no special apparatus, may prove of interest to some of your readers. The difficulties in the way were the fact that there were only about three threads to measure, and the external threads were cut close up to a broad shoulder, while the internal threads were in a practically blind hole. Also, as the objective was of French manufacture, I thought there was a strong probability of the thread being a certain number per centimeter. The objective is what is known as a "French triplet"—that is, it consists of three pieces of brass like that shown enlarged in Fig. 1, each one containing an achromatic lens that could not very well be removed, and each being threaded externally and internally with the same diameter and pitch of thread excepting the bottom one, which has no external thread. By placing the objective in a micrometer caliper and measuring the whole height, Fig. 2, then unscrewing one of the components one whole turn and measuring again, Fig. 3, the difference between these two measures must evidently be the distance between two consecutive threads of the screw under consideration, which I found to be .014 inch. The English equivalent of a centimeter is .3937 inch, which divided by .014 gives 28, which is the number of threads per centimeter on my objective. As the thread was not a very close fit, I took the precaution of unscrewing the parts till the shoulder cleared, before making the first measurement, Fig. 2, and then unscrewing one complete turn from this position, in order to make the second measurement, Fig. 3, thus eliminating the element of "backlash" in the thread.

WALTER GRIBBEN.

Human Nature In Machine Shops.

Editor American Machinist:

I have read with interest the articles by Messrs. Chappell and Jones, in the issues of May 3d and 31st, respectively, commenting upon my letter in the issue of March 12th, entitled "Human Nature as a Factor in the Machine Shop."

Mr. Chappell suggests that I tell something about my own experience in dealing with human nature in the shop.

I have no doubt that we might, any one of us, tell something about the way in which we have dealt with the men with whom we may have been associated, or who may have been in our charge, but, really, would it not appear egotistical to talk about things accomplished along this line?

I agree with Mr. Chappell when he says that there is a quantity of human nature about the shop with graduations too fine to be measured by any micrometers we have up to date; but certainly cannot endorse what he says in regard to treating a large body of men as shop equipment.

In the same paragraph he tells us that in order to get profit out of a machine shop it is necessary to employ a superintendent who is to have full control, etc.; but, mark you, this is immediately followed by the statement, "and do not lose sight of the fact that he has some human nature, and can appreciate square treatment fully as much as any lathe hand in the shop."

Now, why not follow out the analogy? If the superintendent can be influenced for good by square treatment, or, rather, by a consideration of his human nature, why should he not treat the foreman under him with this in view, and the foreman in turn treat the mechanic likewise? But this is virtually conceded by Mr. Chappell when he says, "as much as any lathe hand," in spite of the statement which follows.

It is not to be expected that an employer or superintendent can study each man individually, but there are certain principles which may be applied to the men as a whole.

For instance, when it becomes necessary to introduce a new feature into the shop, it may be done in various ways.

I need hardly explain just how; but, then, you know, it all depends upon how a dish is served, as to whether or not it is palatable.

There is quite a difference in the interpretation of the adverbs *shall* and *may*, although *may* may have the same significance and effect in the shop as *shall*, and possibly will not leave that unpleasant "after taste;" and while it is not always advisable to write *may* where *shall* should be inserted, I believe that the working out of this general principle, would result in a better feeling between the employer and employe.

Talking about orders in the shop reminds me of something else along this line, which

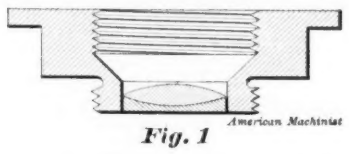


Fig. 1

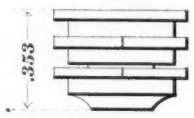


Fig. 2

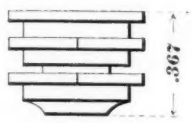


Fig. 3

I think has some bearing on the subject under discussion.

I refer to the almost inevitable "Rules and Regulations."

I know of some shops in which they use an immense amount of cardboard, printers' ink, and picture-frame moulding, in order to keep their men posted as to what they must and must not do.

And, as I have walked through some of the shops in question, and have seen their 18-inch by 30-inch guide-boards posted up in every convenient place, I have thought that possibly they might have been put there to hide some blemish on the wall.

If that was the intent of the owner, they served their purpose most admirably; but I do think that he might have put something more useful or ornamental inside the frames.

He might, for instance, have had some reliable tables of reference printed, and then I have no doubt his men would have used the guide-boards to some good purpose.

As it was, I doubt that ten per cent. of his employes ever took the trouble to read them.

A genuine mechanic, in fact, anyone who is worth having around the shop, does not need to be told those things which anyone with a grain of common sense knows already; and those who have seen the typical rules and regulations (and they are practically the same), will understand what I mean.

I believe there is considerable truth in what Mr. Chappell says in regard to giving a man more pay as an inducement to greater effort.

Twenty-five cents a day added to a man's wages will, in most cases, prove to be a wonderful incentive; and this thought brings me to the consideration of a statement in the article by Mr. Jones.

Mr. Jones believes that men as a body are responsible for the wages they receive as individuals, and cites an instance in which he found it almost impossible to have his pay increased, because the foreman feared that he would be compelled to do the same by others in the shop who were not worthy.

If this were true, I wonder how many of us would try to excel in our work.

If a first class mechanic should be compelled to work for the same wages that an ordinary man received, what would be the inducement to study and to become proficient in the trade?

No, no, Mr. Jones, I do not think that your argument will hold; it may be so in some shops, but I believe that as a rule, employers appreciate the good men in their employ, and are willing to pay for their services.

"PRESTO."

The Isometric Ellipse.

Editor American Machinist:

Since the attention of your readers has been called to the construction of the isometric ellipse, the present may be an appropriate time to illustrate the *positions* which an ellipse may occupy in isometric drawing, and the method of constructing the axes.

The isometric projection of a cube, Fig. 1, is a regular hexagon, and the three visible faces are represented by the equal figures, *o a b c*, *o c d e*, and *o e f a*. While the edges *o a*, *o c*, *o e*, *d e*, *d f*, are diminished in this projection, the diagonals of the faces *a c*, *c e* and *e a* are represented in their true length. Therefore, if we represent a circle on or parallel to either of these faces, the major axis of the ellipse must be drawn parallel to the diagonal of the face.

The visible faces of the cube being perpendicular to each other, are *in general* the positions of the planes of the circles which we may have to represent.

From Fig. 1 we see that the diagonals *a c*, *c e* and *e a* form an equilateral triangle, *i. e.*, assuming that *x y* represents the T-square edge, *a c* is parallel, while *e a* and *e c* are drawn at an angle of 60 degrees to it.

We may, therefore, draw the three projections of the circle as in Fig. 2. The major axis *a b* is in each case equal to the diameter of the circle it represents, and the extremities of the minor axis are determined by drawing *a c* and *b d* at 30 degrees to *x y*. All the major and minor axes are drawn with the aid of the T-square, and the 60 degrees triangle applied to it, as shown in the figure.

Fig. 3 illustrates the application of the foregoing principles in drawing a cylinder in the three positions it may occupy in space, *i. e.*, when the axes are perpendicular to each other. The length *a b* is taken from the isometric scale.

FREDERIC R. HONEY.

Sending Catalogues.

Editor American Machinist:

Your remarks to "Planer Hand" remind me of a case that lately came to my notice: A foreman in a large machine works wrote to a machine tool builder for a catalogue, and received the reply that "he would probably find one on file in the office," with the result (rightly or wrongly) that the foreman came to the opinion (!) that this particular machine tool builder's machinery was no good anyhow and recommended another maker's machine to his employers, with the consequence that the fellow that wasn't

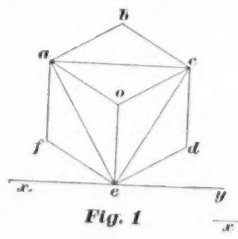


Fig. 1

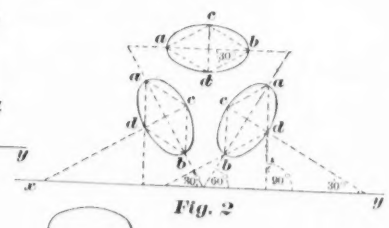


Fig. 2

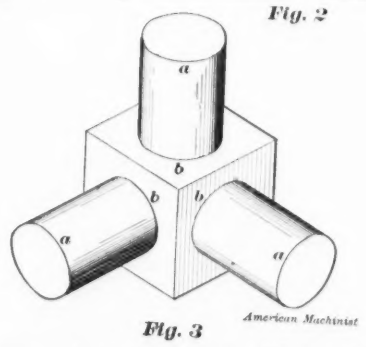


Fig. 3

afraid to send a catalogue to a common, greasy mechanic, got the order—see?

GREASER.

American Shop Methods.

When the members of the Institution of Mechanical Engineers visited the Seraing Works and Hoboken Shipyard of the Cockerill Company, they remarked the slow speed at which most of the machine tools were run. M. Eugene François, engineer at Seraing, lately visited some engine-works in America, and, at a recent meeting of the Société des Ingénieurs de Liége, communicated the impressions derived from his visit. He chiefly turned his attention towards the productive side of the question, with the object of explaining how the Americans, with labor costing twice or thrice as much as in Belgium, manage to sell engines as cheaply as the Belgians. The conditions, he observed, differ greatly. In America the market is very wide, and the subdivision of labor carried to a very great extent; but, in addition, there is a series of reasons which he stated as follows:—(1) simplicity and uniformity of construction, with a larger use of cheap materials; (2) more improved plant, and (3) methodical organization. With respect to the first reason, M. François pointed out how the Americans succeed in economizing labor by confining themselves to simple methods of fitting. He drew a comparison between an Allis and a Cockerill blowing engine, and compared the industrial modes of thought and habits in Belgium and America. American makers create types, design engines from a manufacturer's point of view, to be sold readily and in large numbers; they make everything an article of commerce, which they offer as it stands—take it or leave it. Belgian makers, on the contrary, often design an engine for each special case, taking great pains to adapt it to local conditions, while carefully attending to the observations and even whims of the purchaser. As regards the second reason, he showed the superiority of American machine-tools, which are designed for a large production and easy maintenance, while the machines run at a higher speed, one man attending to several. The use of continually working machines, such as milling machines, planing machines with quick return, polishing machines, machine tappers, portable machine tools, overhead cranes and quick-running lifts, has, he added, become general. With respect to the third reason, M. François dealt successively with the systematic and rational arrangement of the drawing offices in the States, the manner in which patterns and drawings are stored, the centralization of machining and raising steam, decentralization in the production of motive power, the interchangeability of parts, the extended use of delicate measuring instruments, easy methods for intercommunication between members of the staff, and regulations as to the beginning and leaving work by the men.—*The Engineer* (London).

In considering what causes have led to our peculiar industrial conditions as hinted at in the above, it should not be overlooked that this country was fairly established and fully ready for development when the steam engine and the locomotive, by far the most powerful allies of man in the work of civilization, appeared, and, while they merely saved some older countries from impending starvation and depopulation, gave to ours an impetus and a rate of development entirely without precedent. At the same time the opportunities incident to the development of new territory kept wages relatively high, gave men ambition, and forced the employment of every possible device for the economical production of manufactured goods. At the same time these conditions induced for years an immigration of the very best class of people for developing a new country, leaving the less ambitious and progressive at home in the older countries. In other words, Americans have done just what humanity has in the main always done, *i. e.*, adapted themselves to conditions and environment.

The steamship "Faraday" sailed from Messrs. Siemens Brothers Works at, Woolwich, June 12th, having on board 1,600 miles of the Commercial Cable Company's new cable. She proceeded to a point 150 miles off the Irish coast, where she spliced onto the shore end already laid. She then started for Nova Scotia. The cable is expected to be laid by June 30th. This cable is the largest and has a greater carrying capacity than any other ever laid. The tests during its manufacture have been most satisfactory, and the cable has been completed without a single flaw or hitch.—*Engineering and Mining Journal.*

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BREAM'S BLDG'S, Chancery Lane, LONDON, E. C., ENG., or Stefanstrasse 18, LEIPZIG, GERMANY, will receive subscriptions for the AMERICAN MACHINIST, at 16/6 per annum, English currency, or 17 marks per annum, German currency, postpaid.
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Subscriptions received in Australia by W. WILLIAMS, 17 and 21 Fink's Buildings, Melbourne.

NEW YORK, JULY 5, 1894.

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The Assassination of Carnot.

Every American worthy of the name is shocked at the news of the murder of the President of the French Republic.

While all such murders may be said to be without reason, this one seems peculiarly devoid of any possible reason which could influence any other than a savage brute.

President Carnot was a man peculiarly fitted for the difficult position he held—a highly educated gentleman, a man of brains, and an honest man, admired and loved by all who knew him. That he was a true friend of the common people has been abundantly shown, most clearly, perhaps, by the actual death of his coachman through grief.

Carnot came of an illustrious family, and was educated as an engineer. He showed his appreciation of engineering and engineers by the part he took in the entertainment of the American engineers who went to Paris in 1889, all of whom were very favorably impressed by him, and are among his admirers.

As to the crime by which M. Carnot lost his life, not much can be said in the way of denunciation that does not already fill men's minds. At first reported to be the work of Anarchists, this is now doubted, the fact that a dagger was used instead of the more cowardly and more murderous dynamite bomb, adding to this doubt, and indicating that it was simply an uncomplicated assasination for which the murderer is alone responsible. It can truthfully be said that the murdered man was at least in no way responsible, for it is impossible to perceive how he could have conducted the affairs of the French nation more ably, more honestly, or more devotedly.

It is to be hoped that some way may be found to protect such men, whom society places in positions of trust and honor, but perhaps the most regrettable feature of the affair, from a human point of view, is in the fact that this murder will give to every reactionist and tyrant upon the face of the earth an excuse for still further restricting liberty.

Cold Swaging.

Elsewhere in this issue we publish an account of a swaging machine and its work, and give the results of some tests, of general interest to mechanics.

It is a familiar fact that a steel rod drawn through dies, as in making wire, ordinarily has its tensile strength very considerably increased. The fact that a drawn steel wire is still further increased in tensile strength by this cold-swaging operation—an operation which, because it strains or distorts the metal far beyond its elastic limit, would be expected to weaken it is not so well understood, and, so far as we know, the present is the first publication of figures giving the results of tests of unswaged and swaged wire.

The process of cold swaging is, of course, not a new one; our back numbers contain various references to it, and at least one article by S. W. Goodyear, who has given the process considerable attention and whose swaging machine for pointing wire was described in our columns December 31, 1881.

As has also been previously stated, the "Crescent" polished drill rods are cold-swaged to size, and there is evidence going to show that wire may be actually softened by swaging so that it is capable of being bent to a sharper angle without breaking.

A circumstance to be considered, also, in comparing this process with others for reducing diameter of stock, is in the fact that absolutely no stock is turned into scrap or chips.

Since swaging is not done by blows but by pressure sufficient to cause a flow and readjustment of the molecules of the swaged metal, its effect seems to extend equally throughout the piece and in such a manner as to produce effects opposite to what would naturally be expected. It is, perhaps, this quality of doing unexpected things which is most interesting in the process, and which also makes it quite unsafe to fix a limit to its applicability.

The Overhead Trolley.

The complaint against the overhead trolley electric roads in the vicinity of New York increases rather than decreases, as we predicted would be the case. It is only fair, however, to state that the greater part of the complaint is not against the overhead wire, but would be the same with any system by which it would be possible to run cars at dangerously high speeds through crowded streets. The wire is just as dangerous as it ever was, but its doings are so far eclipsed by the running down of people through reckless speed as to be, for the time, lost sight of. It is the case of an earthquake being worse than a flood, or something of the sort.

Regarding speed, the writer feels sure that an electric car in which he crossed Brooklyn not long since was several times driven at a speed of not less than twenty miles an hour. The speed at times caused considerable comment by the passengers, and yet it is not probable that any one of them would be willing to swear positively that it exceeded the legitimate ten miles, or, if he did so swear, that skillful cross questioning would not put him to confusion. So it will always happen in the case of an accident by which life is sacrificed that the testimony as to speed is no better than guesswork.

The only way the large monthly list of killed and maimed can be reduced is by fixing a limit of speed, with a heavy penalty for exceeding that speed whether it results in accident or not; not waiting for the running down of somebody before action is taken. While it will generally—practically always—be impossible to prove over-speed just at the time of the accident, it will be an easy matter to determine if the speed is exceeded at other times, if the doing so is seriously undertaken. The aim of the authorities should be to prevent killing and maiming rather than to mete out punishment when they occur. The punishment is well enough in its way, but it will not restore life or limb.

The almost every-day arrest of a conductor and a motorman has come to be the broadest kind of a farce. It is well known that these men must make the time with their cars or lose their positions, and it is equally well known that to do this they must exceed a safe speed at every opportunity.

The blame should be put where it belongs, and it should be seen that the company responsible is heavily fined every time a specified speed is exceeded.

There are, in the instance of roads that run across considerable spaces of open country, parts of the route over which high speed may be properly permitted, and it appears to be the cars that are run over such routes that are run the most recklessly when city limits are reached. This is natural enough; it is hard to get down to easy running after speeding up, at will.

One difficulty in the matter of speed is undoubtedly owing to the fact that passengers do not feel in any particular danger, and are rather inclined to encourage fast running. It is the unfortunate foot travelers, and especially children and the infirm, that are in danger. If the chief danger were to the passengers, the remedy would soon be applied. There is no less reason why it should not be applied in the interest of those who must cross the streets on foot.

Some of those who have been making big figures on the horse-power of locomotives may be somewhat startled to see a statement made in a pamphlet recently issued, under the direction of Prof. Wm. F. M. Goss, by Purdue University, describing the new special laboratory for testing locomotives. In speaking of the traction dynamometer which is to be put in to weigh the draw-bar pull, it is pointed out that while at slow speeds and heavy pulls slight errors in determining draw-bar pulls are not important, at high speeds with relatively light pulls, an error of, say, 50 pounds would amount to a very considerable percentage of the total power exerted; for "a locomotive which at ten miles an hour may pull 12,000 pounds will have difficulty when running 60 miles per hour, in maintaining a pull of 2,500 pounds."

A pull of 2,500 pounds at 60 miles per hour amounts to 400 horse-power and as the figures given are based upon considerable experience in weighing draw-bar pulls, they are significant. Of course, we know that only one locomotive has so far been tested there and that there is considerable difference in size between that locomotive and some of the largest ones in passenger service; but there is also considerable difference between 400 horse-power and 1,400 or 1,600 horse-power. It is true, however, that indicated power in a locomotive differs from draw-bar power more than the former does from brake power in stationary engines, even when indicated power of the locomotive is correctly measured.

The Redoubtable Fink.

Fink, with his oil mixture, his testimonials, and his haste to close a contract and catch a train, has been, by our exposures, entirely driven out of machine shops, but we occasionally hear of him elsewhere. He has recently been operating among wood-working establishments in New York City, one of our readers, a manufacturer of a device for promoting economy in the use of steam, finding recently that some of the money saved by him for his customer had been wasted upon Fink. Fink now, in some cases, accepts a partial payment upon supplying the formula for his mixture, with the understanding that he is to return for the balance—a return which several men are still anxiously waiting for.

Literary Notes.

THE TINSMITHS' PATTERN MANUAL. Patterns for Tinsmiths' Work. By Joe. K. Little, C. E. For tinners, coppersmiths, plumbers, zinc workers, and sheet-metal workers generally.

The most unsatisfactory way for developing surfaces, or for laying out sheet metal work, is to follow some fixed rule for each particular article that may present itself, without knowing the principles upon which the rule is based. The metal worker has to deal with many articles varying greatly in form, and to remember the rules for all particular forms burdens the memory unnecessarily, creates doubt, leaves no means for guarding against errors, and, in the end, may lead to spoiled work with all its accompanying evils. The author takes pains to avoid such results, and, therefore, applies the geometrical principles to laying out sheet-metal work. From such a foundation to work from, the workman will have greater confidence in his work, need not memorize rules, will save time and labor, and the results will be far more satisfactory than by following the various methods in general vogue.

The examples given cover a large variety of work, which, if thoroughly understood, will enable the workman to lay out patterns for almost all forms of articles that may come along in the practice of sheet-metal work. We can recommend the book as a valuable and reliable one. It is published by the American Artisan Press, 69 Dearborn street, Chicago, Ill. Price not given.

INDUSTRIAL EDUCATION.—The Eighth Annual Report of Commissioner of Labor Caroll D. Wright, relates entirely to the subject of industrial education, and in the report, as published, will be found a very complete and comprehensive resumé of the subject with information concerning the schools and methods of this and other countries in which such education is given. The classification and indexing in connection with the reliable character of the information given make the work a valuable one for study and reference by all interested in the subject.

Lucian Sharpe, of the Brown & Sharpe Mfg. Co., has gone to Europe for the summer, partly on business, and partly for pleasure.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(309) C., ———, Ind., writes: Please inform me of some simple method of designing a slide valve to give economical steam distribution, or give me the title of a book treating entirely on proportion and construction of slide valves. *A.*—"Slide Valve Gears," by F. A. Halsey, will, we believe, suit your purpose very nicely. It is published by D. Van Nostrand Company, New York. Price, $1 50.

(310) A., Chicago, Ill., writes: Please give me a receipt for a cement or glue for fastening felt to a steel door or lid, the felt is to act as a packing. *A.*—First give the part of the door, which is to be covered with the felt, a coat of best white lead paint; when this has dried hard, coat with best Russian glue, dissolved in water containing a little vinegar or acetic acid; this will hold the felt.

(311) A. M., New York, writes: Please let me know how much power will be developed by a weight of 50 pounds attached to a rope which passes around a wheel 3½ inches diameter, the weight being allowed to fall freely, as shown in sketch. *A.*—In falling the weight will store up energy; and, leaving friction out of consideration, the wheel will practically have no influence on the amount of stored up energy, hence we may leave it out of the question. In examples of this kind we have to deal with stored up energy. During the first second the weight will fall through a distance of 16.1 feet (approximately), hence the stored up energy at the end of a second will be $16.1 \times 50 = 805$ foot-pounds. Before the weight can be brought to rest this stored up energy must be used up, and if used up in one minute, then $\frac{805}{33{,}000} = .024$ horse-power will have been expended. During two seconds the weight will fall through a distance of 64 4 feet, and the stored up energy will be $64.4 \times 50 = 3{,}220$ foot-pounds, and if this stored up energy is used up in one minute, then $\frac{3\,220}{33{,}000} =$ 0.097 horse power will have been expended. From this it will be seen that the horse-power will depend on the stored up energy, and the time during which this stored up energy is used up. 2. Would the same apply to a rotary engine using 50 pounds of steam at a radius of 1¾ inches? *A.*—No. 3. Will the exhaust steam of one engine drive another engine? *A.*—Yes, provided the engines are arranged on the same principle as that of a compound engine. In regard to the sketch of the pump you have sent us, the design will not work.

(312) Y. B., Toronto, Canada, asks: What book can you recommend to a draftsman for designing parts of machinery, such as cylinders, piston rods, etc.? *A.*—The different parts of steam engines, or parts of other machinery, cannot be designed by any set rules. "The Elements of Machine Design," by W. C. Unwin; "Steam Engine Design," by J. M. Whitham; "Manual of Marine Engineering," by A. E. Seaton, and many other books of the same class are good books for a draftsman to have. A successful designer must also have a good knowledge of the strength of material, which also implies a knowledge of mechanics, and this branch cannot well be mastered without having a knowledge of geometry, algebra, and arithmetic. Hence, to be a good designer, a person must have a sound education, experience, and good common sense. Although books such as we have mentioned are extremely valuable, they will be of no use to any one, unless he has an education which will enable him to use them as they should be used, and enable him to supply such rules for special cases, as he will not find in any book. 2. What is the proportion a boiler should have for a given size of cylinder, I mean how many times larger? *A.*—Boilers are not proportioned in this way. The first thing that should be known is the power the engine is to develop; then the surrounding conditions must be considered so as to determine a suitable type of boiler. When this has been decided upon, the grate surface must be computed to suit the kind of fuel to be used, and the conditions under which the boiler is to be worked, and from this the amount of heating surface can be determined, and proper arrangements made for the escape of gases. Of course, before the design of the boiler is completed, other things must be considered, which we need not mention here. 3. Why cannot air be made to perform the same work as water? Could not air be heated in one vessel, as a boiler, for instance, and then led to a cylinder in the same manner as steam? *A.*—Air and water are two different substances, and require different treatment. In gas engines, which are simply hot air engines, the working air is heated in the cylinder, which is also the furnace, heat being produced by the rapid combustion of the fuel in the cylinder—so rapid as to be called an explosion. The fuel is an inflammable gas. Air is also frequently compressed, and then made to drive other machinery.

(313) J. A. C., Valparaiso, Ind., writes: In our water-works system we are having trouble with the inlet pipes from lake to well, and the question has come up as to the quantity we should get in gallons in 24 hours through a pipe 12 inches in diameter, and 675 feet long with one elbow, and with a head of 18 inches. I make it 856,720 gallons using the formula

$$m\sqrt{\frac{\text{Diam. in feet} \times \text{total head in feet}}{\text{Total length in feet} + 54 \text{ diam. in feet}}}$$

taken from one of the engineer's pocket-books, and deducting 25 per cent. for loss. Our civil engineer makes the amount that we should get 2 880,000 gallons, using the formula $8\ 03\ \sqrt{h}$, and making no deduction for loss. Kindly state which is the most correct formula to use for computing the amount of water we should get through the pipe under the above conditions. *A.*—The discharge of water is not only affected by the diameter of the pipe but also by its length, condition of inner surface of pipes, resistance at entrance, and resistance due to elbows, all of which your engineer seems to have neglected. To compute the discharge we first find the velocity. For clean iron pipes, either smooth or coated with coal tar varnish, and laid with close joints, straight and of uniform size throughout, the following formula may be used:

$$v = \sqrt{\frac{2 \times g \times h}{1.5 + f \times \frac{l}{d}}},$$

in which $g = 32.2$, $h =$ head in feet, $l =$ length of pipe in feet, $d =$ diameter of pipe in feet, f a friction factor for which a value of 0.24 is taken, and $v =$ velocity in feet per second. Now, substituting for the symbols in the formula their values, we have

$$v = \frac{2 \times 32\ 2 \times 1.5}{1.5 + .024 \times \frac{675}{1}} = 2\ 3 \text{ feet.}$$

Multiplying the velocity in feet per second, as found above, by the cross sectional area of the pipe in square feet, we get the discharge in cubic feet per second, which gives us

$$2.3 \times .7854 = 1.80642,$$

or $1.80642 \times 3600 = 6503$ cubic feet per hour. Reducing to gallons we have $6503 \times 7.48 = 48642\ 44$ gallons per hour, or $48642.44 \times 24 = 1{,}167{,}418$ gallons for 24 hours. The elbow will reduce this discharge a little; to compute this loss we should know the radius of the elbow which is not given. If, however, the inner surface of the pipes is not smooth, and not of a uniform diameter, and the pipes not laid straight, the discharge as computed above may be reduced to nearly 50 per cent. or about 600,000 gallons.

(314) C. M., Yonkers, N. Y., writes: Please look over the inclosed diagrams, and give me your advice. The first sketch shows the main shafts of two engines, side by side, with a propeller shaft between them. These shafts are geared so that the propeller shaft will make two revolutions to one of the engine shafts. What will be the loss in power due to this gearing? *A.*—From 2 to 4 per cent. 2. The second sketch shows a section and piston valve of a compound engine. The valve distributes the steam in both cylinders, it has no lap. Please give me your views of the working of this valve? *A.*—The principle upon which this valve is constructed is all right, but it seems to us that it is an infringement on existing patents. The valve as shown in the sketch will allow the steam to follow the full stroke of the high-pressure piston, which will not be conducive to the economical use of steam. 3. The cylinders are 6 and 18 inches diameter, stroke 6 inches, how many expansions will there be? *A.*—The area of the small cylinder is 28.27 square inches, that of the large cylinder is 254 47 square inches, hence the ratio of volumes will be $\frac{254.47}{28.27} = 9$. The number of expansion is found by the following formula,

$$E = e\,R,$$

in which $E =$ total number of expansions, $e =$ number of expansions in the small cylinder, and $R =$ ratio of volumes. The steam following full stroke in the small cylinder, the number of expansions in this cylinder will be 1, hence, according to the foregoing formula the total number of expansions will be 9. 4. The steam pressure is 250 pounds, number of revolutions 400 per minute, what will be the horse-power of this engine? *A.*—The engine, non-condensing will develop about 175 horse-power. 5. What should be the diameter of the steam and that of the exhaust pipe? *A.*—Steam pipe 1½ inches diameter; exhaust pipe, 3½ inches diameter. 6. What should be the size of all the ports? *A.*—The steam ports we should give an area of 7 square inches each, and the exhaust port, 8 square inches. 7. What should be the diameter of the piston valve? *A.*—This cannot well be determined without making a drawing of the valve. The diameter should be such as to give the ports the areas as stated above, the diameter of the valve will probably be 4½ or 5 inches. 8. What size boiler will be required for two engines of the above size? *A.*—The boiler should have a grate surface of 70 square feet, and a heating surface of 2 240 square feet. The dimensions of the boiler can be determined only by making a drawing of the boiler containing the given grate and heating surface. We have no time to make the drawing.

(315) H. J. S., Cleveland, O., writes: I noticed in one of your issues a drawing of a prism, as shown in Fig 1. I have always understood that in showing two views of a thing, the lower view, when the paper is folded back, should be directly underneath the thing shown; under these conditions the drawing of the prism should be made as shown in Fig. 2 Please set me right. *A.*—In making a geometrical drawing of any object, a horizontal and a vertical plane of projection are always used; sometimes a greater number of planes of projection will have to be employed, but those we have named are the principal planes, and a less number cannot be used for the complete representation of simple objects. The end view of these planes we have shown in Fig. 3, $X\,X$ being the horizontal plane of projection, and $Y\,Y$ the vertical plane of projection. It will be seen that these planes form four diedral angles; first, the angle above the horizontal plane and in front of the vertical plane; second, the angle above the horizontal plane and behind the vertical plane; third, the angle behind the vertical plane and beneath the horizontal plane;

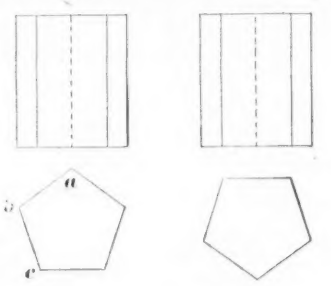
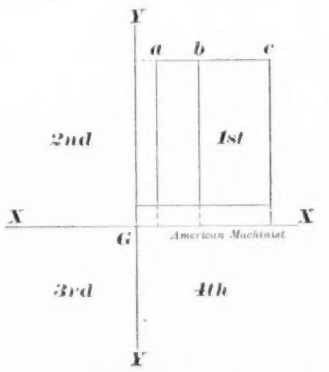


Fig. 1 *Fig. 2*



fourth, the angle beneath the horizontal plane and in front of the vertical plane. The object of which a drawing is made can be placed in any one of these angles; some authorities place the object in the third angle, but the general practice is to place the object in the first angle, as shown in Fig. 3, and then all the points of the object are projected on these planes, as indicated by the dotted lines. The plane of the paper is generally assumed to be the horizontal plane of projection, and the vertical plane is assumed to be perpendicular to the plane of the paper. If, now, the prism referred to is projected on these planes, and the vertical plane turned away from the horizontal plane around the line in which these planes intersect until it coincides with the paper, then the elevation of the prism will be above its plan, and the two views will have the relative positions as shown in Fig. 1. A projection of the prism as shown in Fig. 2 can be obtained according to the rules of descriptive geometry by placing the prism in the second diedral angle, but we cannot call to mind at present a single instance in which such a course was advocated. Although it cannot be said that your way of showing the prism is absolutely wrong, it can be said that it violates the rules of custom and may lead to confusion.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gears, Lex'n, Mass., & Phila, Pa. See p. 12

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Turret Drills, 6 spindles. A. D. Quint, Hartford, Ct.

"National" Lathe Chucks. Best made, page 15.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 157 William St., N. Y.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St. N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Best Presses and Dies for all sheet metal work. Ferracute Machine Company, Bridgeton, N. J.

Air Compressors for every possible duty. Clayton Air Compressor Works, 26 Cortlandt street, N. Y.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

"Pumping Machinery." New book, 450 pp. 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton avenue, Philadelphia, Pa.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

Grinders' Supplies—
Emery, emery wheels, grinding machines, knife powders and sharpeners, paste and liquid polish, whetstones, etc., etc.; quick process and large stock. Customers annoyed by the delays due to long processes and small stock can get goods in a hurry by buying of the
Tanite Co., New York City, Cincinnati, Ohio, and Stroudsburg, Pa.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid. Published by John Wiley & Sons, 53 East Tenth street, New York.

Testing Indicator Springs.

BY EDWARD J. WILLIS.

Hydraulic pressure is not suited for the purpose of testing indicator springs, as, in the first place, it does not heat the indicator, and in the second the leakage of the instrument prevents the successful handling of water pressure. Steam is therefore necessary, and its pressure is generally measured by a steam gauge. The ordinary steam gauge is not accurate, and unless the one used be of excellent quality it will probably contain more error than the springs which are to be tested. It is not unusual to find a gauge reading three or four pounds more on a falling pressure than on a rising pressure, and even the very best seldom have less than two pounds difference. This is due chiefly to the backlash of the pinion and gearing, and the fact that the very small force which the tube exerts for small changes of pressure is not sufficient to start the train of mechanism communicating its motion to the hand. It is usual to assume the true pressure half way between the reading on a rising pressure, and that on a falling one. This is probably correct with a well selected gauge. A mercury column is the best method of measuring pressure. It is not much more expensive than a first-class standard gauge, and is far more reliable and accurate. The cost of materials for one built by the writer was under $15, being $4.50 for mercury, $4 for 30 feet glass tubing, and the rest for pipe fittings, connectors, etc. A good workman could put one up in two days. The column is far preferable to the so-called "standard gauge" for several reasons. First, it is reliable, because when anything goes wrong with it, which is not likely, it simply prevents its working and does not vitiate its readings.

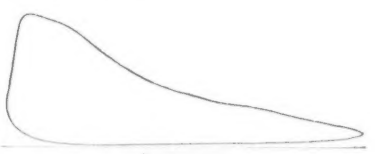
A gauge, however, gets out and sometimes considerably so, without giving even a hint as to its condition. The column is

far more delicate, as one pound is approximately two inches, so that one-twentieth of a pound can be read with ease. When properly scaled the only correction needed is for the change of density of the mercury on expansion due to changes of temperature, and as this is less than one-tenth of 1 per cent. for every 10° Fahr. it becomes negligible if the chamber be filled with water to prevent the steam coming in contact with the mercury. The column, moreover, is not subject to oscillations, but like a dead-beat galvanometer goes to its reading immediately. If there is any doubt as to the specific gravity of the mercury used, it can be readily determined in a specific gravity flask, and the point settled before the scale is marked off.

While the steam gauge has a difference between its reading on a rising pressure, and that on a falling one such is not necessarily the case with the indicator. It is, however, a frequent occurrence with the latter instrument. There are two causes for the indicator reading different on rising and falling pressures. First, the backlash in the pencil movement, and, second, the friction of the piston. The first can be avoided by adjustment of bearings and renewal of worn parts. The friction of the piston is more serious and is chiefly dependent upon the amount of clearance allowed between the piston and the cylinder, and also upon the cleanliness of the instrument and its state of lubrication.

In the ordinary indicator with a piston of half-inch area the piston is usually from .0010 to .0018 smaller than the cylinder. Such a piston is not leaky and falls easily back and forth when its spring is removed. It is doubtful, however, if such an instrument would give the same reading on rising and falling pressures even if properly cleaned and well lubricated. The light piston surrounded by steam reaches a higher temperature than the cylinder which is exposed to the air, and, probably, its greater expansion, or the side pressure due to the reaction of the spring, causes a considerably increased friction. To be sure of getting identical readings on both rising and falling pressure there should be a clearance of full .001 around the piston or the cylinder should be .0025 to .0035 larger than the piston. Such clearance will cause leaking, and at over 50 pounds the card may be soiled by the spattering. If the above precautions against backlash and piston friction be taken identical readings should be obtained on rising and falling pressures, and, further, with the excellent pencil movements now on good instruments the readings should be very closely proportional to their pressures. In other words, almost the same percentage of error should appear at all points of the scale, and in consequence the average correction can be directly applied to the mean effective pressure. The proportionality of record is due to the fact that, practically speaking, the pencil movement is both parallel and proportional to the piston movement and that the spring, if properly used, is not strained beyond its elastic limit.

If the pencil movement is not throughout practically proportional to the piston movement it involves a set of corrections depending upon the position on the drum of the atmospheric line both at the time of spring testing, and also at the time of taking the card to which the corrections are to be applied. It is best with springs over 40 pounds to record every 10 pounds up and down, and possibly every five pounds with weaker springs would be advisable. It is well to remember in figuring the spring correction that the atmospheric line is fully as apt to be out as any of the others, and probably more so, as when this line is drawn, the instrument, so to speak, is in a state of relaxation, and its parts are not thrown together by the opposing force of the steam. Moreover, the mean effective pressure is not estimated from the atmospheric line, but from the line of back pressure, which does not always coincide with the atmospheric line. Spring errors are not usually great. It is rare to find a spring of one of the first-class makers with an average error exceeding 3 per cent. As much cannot be said of the steam gauge.



Foul Piston

With the object of learning if the piston clearance recommended above when testing springs had any appreciable effect upon the usual card, the following experiment was made upon a 13 inch by 18 inch engine running about 125 revolutions per minute. Two duplicate instruments were attached directly to the head end of the engine, and their drums were connected to the same hard-drawn wire. The test was conducted with the reversal of indicators and springs, pneumatic application of pencils, etc., as described in the AMERICAN MACHINIST of November 23, 1893. One indicator had the usual piston with .0012 inch difference in the diameter of the cylinder and piston, and was fairly steam-tight. The other instrument had a piston with over .001 clearance or a difference of .0029 between the diameter of its piston and cylinder. It leaked quite badly, and when the card was taken spattered oil and water on the card. The results were as follows:

Boiler Pressure.	Revolutions.	Scale of Spring.	Mean Effective Pressure.		Horse-power.		Springs Used.
			Tight Piston.	Loose Piston.	Tight Piston	Loose Piston.	
76	115	50	29.25	31.24	20.5	21 9	5 and 7
76	115	50	30.44	32 41	21.4	22.7	5 and 7
76	115	50	30.54	31 59	21.4	22.1	5 and 7
76	118	50	25.74	26.32	18 5	18 9	7 and 5
76	118	50	25.86	25.74	18 6	18 5	7 and 5
76	118	50	27 85	27.29	20.1	19.6	7 and 5
Average			28.28	29.10	20.1	20.6	

The loose piston appears to give on an average about 2½ per cent. higher result than the steam-tight piston. As this does not occur uniformly throughout the test, it is possible this 2½ per cent. may be due to some cause other than the difference in piston diameters. Piston friction does not appear to always produce lower figures, as in the test which will be found further on an exactly opposite result is to be noted.

Clean Piston

Boiler Pressure.	Revolutions.	Scale of Spring.	Mean Effective Pressure.		Horse-power.		Springs Used.
			Tight Piston.	Loose Piston.	Tight Piston.	Loose Piston.	
75	132	50	31.00	30.07	24.9	24.2	7 and 5
75	132	50	34 51	34.28	27 8	27 6	7 and 5
75	104	50	34 17	33.06	21.7	21.0	5 and 7
75	104	50	32 64	31 24	20 7	19 9	5 and 7
Averages			33.08	32.16	23.8	23.2	

If two indicators duplicate in every respect, except that one has considerable piston fricton, be attached to the same steam pipe, there will be noted the following differences in their actions: If steam pressure be turned upon both, simultaneously, the easy-moving piston will carry its pencil immediately to its reading in a manner similar to the action of the split-second hand on a stop watch; the other instrument will neither respond so promptly nor probably reach quite so high a reading. The fricton of its piston prevents its starting with a small pressure, reduces its velocity while in motion, and arrests its movement before there is an exact equilibrium between the pressure of the steam and the reaction of the spring. If the pressure of the steam be reduced very gradually the pencil of the easy fitting or clean instrument will descend with an even and imperceptible motion like a clock hand. The other pencil will, however, move downward by jerks or steps—each step being evidence that the difference between the reaction of the spring and the steam pressure is greater than the friction of the piston. This last jagged line of falling pressure has for a long time been called the indication of a sticking piston. The rising retardation has not been so often noted, for unless the instrument be very foul it is not so marked. When, however, the piston has considerable friction it is more marked in its effect on the card than the jagged line of the expansion curve. This rising retardation of the pencil produces the effect of a slow admission, for the pencil instead of rising promptly, as it should when steam enters, moves slowly, and the drum meanwhile turning under it gives the slanting line of tardy admission. This action is plainly shown in the pair of cards given in the figure, which were taken simultaneously by duplicate instruments, from the same end of the 13 inch by 18 inch engine above referred to. The indicators were connected and handled, as previously described, the only difference being that the tight piston was made to bind badly by coating it with melted rubber gasket packing which made it very difficult both to enter and extract the piston. The same characteristics appeared in all pairs taken, and below are the mean effective pressures and horse-power as given by the two instruments.

While the effect of even slight friction is plainly shown on the slowly changing pressure used for spring testing it is doubtful if it materially affects the horse power of the usual card, although, as shown above, it may when excessive mislead in regard to the condition of the valves.

Inside Micrometer Caliper—Templates—Filing Jigs.

BY JOHN T. USHER.

The inside micrometer caliper shown at Figs. 1 and 2 was designed by the writer for his own use several years ago, and subsequently patented, but never placed on the market.

Fig. 1 is a side elevation half longitudinal section of the tool, and Fig. 2 is a similar elevation of the same instrument with longer (plain) tail pieces.

The instrument, as shown in Fig. 1, consists of a cylindrical body, *A*, which is bored and threaded at *B* to receive the tail piece *E*, and the screw *c*. The body *A* is also threaded on the inner end, on the outside at *G*, to receive the adjusting nut *J* (which is cylindrical and of the same diameter as the body *A*, thereby serving to steady the screw *K*), and on the inside at *G'* to receive the measuring screw *F*. The body has on the inner end two radial cuts or slits, *H*, to admit of adjustment for wear of the measuring screw *F* in an obvious manner by means of the adjusting screw *J*. The sleeve *K* is screwed onto the measuring screw *F*, and held in a fixed relation with the measuring screw and terminals by means of the nut *M*, which arrangement permits of adjustment for wear on the measuring terminals. The screw *c* has a radial cut or slit on one side, which serves to permit the bore of the chuck to close somewhat when the screw is forced into the threaded bore *B*, thus forming, when used in connection with a plain tail piece *E* (Fig. 2), a chuck. The bore of the screw *c* is extended through the shoulder of the body *A*, as shown near *Q* (Fig. 1), and nearly throughout the entire length of the measuring screw *F*, as shown at *N*. This permits of a plain tail piece *E* (Fig. 2) being used (instead of a tail piece *E* with the location collar on it, as shown at *Q*, Fig. 1), when the instrument is to be used for other than standard measurements. The graduations on the body *A* and the sleeve *K* are of the usual form.

In using the above instruments for standard measurements, the tail pieces with collars on are used, the capacity of the instrument being increased or decreased by means of the measuring screw, and by the insertion of longer or shorter tail pieces, as required. But when making shrinkage, tight or loose fits, where merely a stated allowance is required, then the straight tail pieces may be used. The straight tail pieces being made to slide in or out to the size required, and held by merely tightening up the chuck screw *c* until it is closed upon them, the adjustment to correct size being made by the measuring screw.

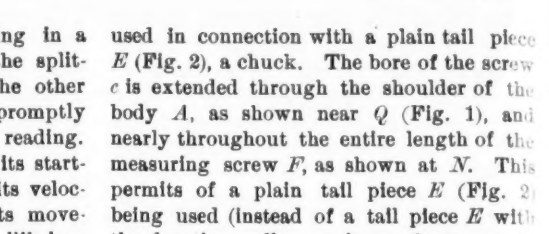


Fig. 1

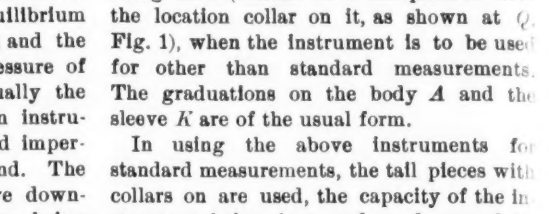


Fig. 2

INSIDE MICROMETER CALIPER

In making templates for the laying out and duplication of parts, there should be depressions or lugs, which fit into or over the piece it is to be used on, at such points as will not be changed by any future process or operation to which the piece may be subjected. The template should be so arranged as to be used for laying out as many surfaces and points as can be practically covered by one template, and it should be made, also, with a view to using it as a test gauge after the various operations have been completed on the piece it is used upon. By this means it is possible to duplicate work within a reasonable degree of accuracy, in most cases, sufficiently close to answer all practical purposes.

Templates for locomotive engine frames are usually connected together by means of iron or steel bars of any thickness or width desired, and templates for fire engine and hose carriage frames, and similar purposes are cut out in one piece from sheet-iron or steel. For other purposes templates may be, and are made, in different ways to suit the requirements of the case. In some cases they may be so arranged that they can be used for both male and female templates, thereby avoiding the necessity of making two templates. Templates of one kind or another may be seen in nearly every establishment doing machine or iron work, and a study of their various uses and requirements will well repay any time spent thereon.

The use of jigs on vise work does not appear to have been so extensively cultivated as in other branches of the trade, or even so much as their utility and merits would seem to warrant.

The accurate measurement of distances and

alignment of holes, surfaces and parts can readily be secured in designing and making jigs of any kind, and these features may usually be combined so as to expedite the process the jig is intended for, but there should always be an entire absence of complication. Jigs adapted for vise work may very properly be divided into three classes, viz., jigs used for the purpose of facilitating and insuring the accurate alignment and the locating of one or more parts of the work with some other part or parts, drilling jigs, and filing jigs.

Jigs used for the alignment and locating of parts should be made in such manner that when the part is fitted on or into the jig, no subsequent fitting will be required when the part is assembled with other parts on the machine, or whatever it belongs to.

In Figs. 3 and 4 is shown side and end elevation of a jig (with rod in position) for lining up connecting rods for engines.

A A (Figs. 3 and 4) is the connecting rod; *B B*, a base plate, into which is fixed a wrist pin *C C*, upon which the connecting rod is suspended; *D D*, a straight-edge laid across the butt end of the connecting rod. To line up the rod laterally, it is placed on the wrist pin *C C*, and the brasses are then tightened up about the same as they would be on the engine. A straight edge is then laid across the butt end of the rod at any desired point, as shown at *D D*. The distance is then measured from the base plate to either the upper or under side of the straight edge (as shown at *E E E*) by means of calipers or a surface gauge. The longitudinal alignment of the rod is secured by first measuring the distance from the base plate to either the upper or under side of the rod, as shown at *F F*, and then after inverting the rod upon the wrist pin *C C* remeasuring the distance in the same way and at the same point. If the distances measure the same with the rod in both positions, the rod is in line, but if not, then the brasses must be scraped or filed until it is in line. The other end of the rod is lined up in the same way, by substituting a wrist pin the right size for the brasses, or by having the plate long enough to accommodate a wrist pin for each end of the rod.

In like manner every part of any engine or machine can be fitted throughout ready for assembling, by the use of properly designed jigs, and more expeditious and accurate results obtained by their intelligent application than by any other method.

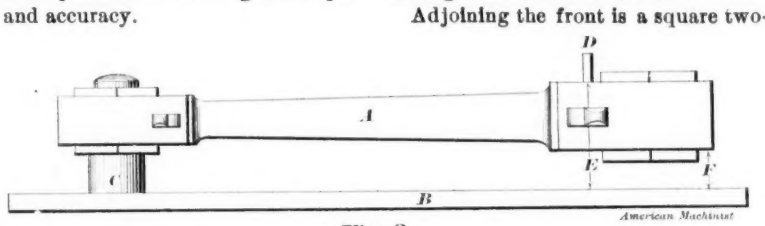


Fig. 3

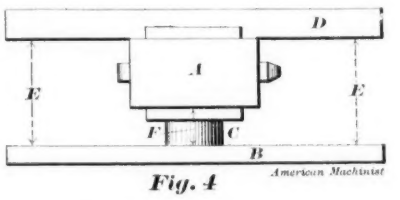


Fig. 4

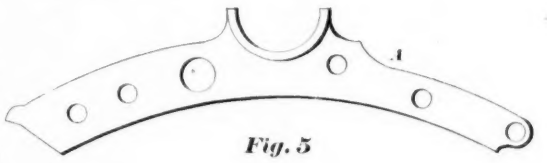


Fig. 5

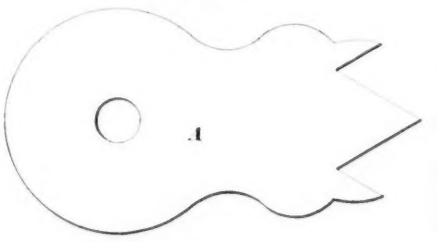


Fig. 8

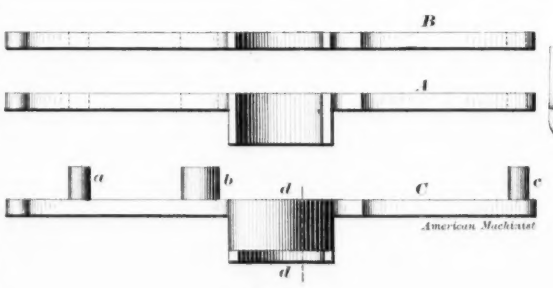


Fig. 6

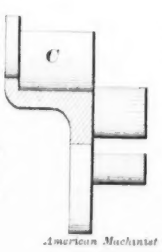


Fig. 7

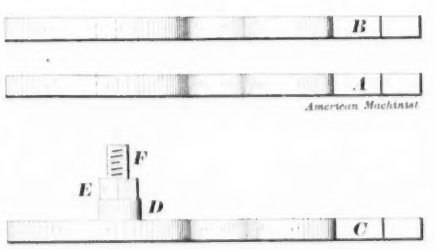


Fig. 9

Filing jigs are used principally on work and surfaces having an irregular shape or form; and on those surfaces of larger and heavier work to which they are adapted, or which are difficult or inaccessible by the ordinary methods.

Amongst other things on which filing jigs have been successfully used are links for reversing gears, gridiron valves, cams, connecting rods and straps, gun and sewing machine parts, etc. And, in the author's opinion, it will usually pay to make a filing jig for almost anything upon which there is much filing or hand-work, if six or more pieces of the same have to be made.

A filing jig usually consists of two steel or iron plates with hardened edges varying from ¼ inch to 1 inch in thickness corresponding in shape to the surfaces upon which they are to be used.

The plates are always connected by one or more dowel pins, which serve to locate one plate with the other, and the work between them. The position of the dowel pins is dependent on the nature of the work, sometimes being located on the outside of the work, but in most instances passing through it.

Figs. 5 to 9 show two forms of filing jigs and the parts upon which they were used, which, in this case, are two plates that are fitted on the side of an old-style gun, and, which, on account of their peculiar form and other considerations, will furnish good examples.

At *A A* (Figs. 5 and 6) are shown side and plan views of the part upon which is used the first form of filing jig, *B C* (Fig. 6) which shows plan view of the filing jig, and Fig. 7, section of Fig. 6 at *d d*, showing part *c*.

The side view of the jig plates *B* and *C* (Fig. 6) would correspond in shape to Fig. 5.

In this case, three dowel pins, shown at *a b c* (Fig. 6) and *a b* (Fig. 7) are used which feature is always desirable when possible, as when three or more dowel pins can be successfully employed the opposite plate of the filing jig, and also the work, can be located and operated on with greater precision and accuracy.

At *A A*, Figs. 8 and 9, are shown side and plan views of the part upon which is used the second form of filing jig, *B C* (Fig. 9) which shows top (plan) view of the filing jig, the side elevation of the same corresponding to that of Fig. 8.

In this instance only one dowel pin, shown at *D E F*, Fig. 9, can be used as the part *A A*, Figs. 8 and 9, has but one hole in it. In order to locate the parts *B* and *C* (Fig. 9) of the filing jig correctly the dowel pin is turned at *D* to fit the hole in the work, and squared at *E* to fit into a square hole as shown by the dotted lines in *B*, thereby serving to locate the part *B* accurately with *C*. The dowel pin is threaded at *F* for a nut by means of which the work and the jig are held together. In this and similar instances two or more pieces may be filed together by extending the length of the dowel pin or pins to suit the requirements, but when only one piece is filed at once the jig may consist of one plate only if desired.

A Washington Mechanical Laboratory.

The Mechanical Engineering Department of the Washington Agricultural College and School of Science, Pullman, Wash., is just moving into its new $10,000 building, and a brief description of it may be interesting to our readers.

The exterior of the building forcibly reminds one that the designer has taken advantage of the most modern ideas of shop-building. The major portion of the building is one story high of "mill construction." An original and ingenious idea is developed to obviate the necessity of monitors on the roof. In the building, which is about 90 feet square, the shops are arranged around an open court, the roof of the court being 7 feet below the roof of the shops, which pitches from the court ½ inch to the foot. High up in the shops open large transom windows into the court, and as the exterior windows are also fitted with large swinging transoms at the top, splendid light and ventilation is assured. The liberal windows of the building are glazed with translucent glass, thus insuring soft and easy light.

The main part of the building contains a wood and pattern shop, 31 feet by 90 feet; machine shop, 38 feet by 60 feet; forge shop, 31 feet by 36 feet; foundry, 28 feet by 31 feet; and experimental laboratory, 31 feet by 31 feet. The space under the court being well lighted by skylights, is utilized for locker, toilet and tool rooms, the latter having small doors opening into each shop through which tools are drawn.

Adjoining the front is a square two-story wing of more architectural pretentions than the remainder of the building. In the front of this wing is the main entrance and a stair hall extends from this entrance to the locker and toilet rooms. Opening from the hall is the director's office and recitation rooms 10 feet by 18 feet and 18 feet by 22 feet, respectively. The second story contains the drawing, designing and blueprint rooms.

The roof of the two-story part is of Merchant & Co.'s Spanish tile—the exterior walls are faced with pressed brick and all interior walls are of brick, making a very substantial and nearly fire-proof structure.

The heat, light and power for all the buildings on the campus are generated in an isolated plant, under charge of this department, which forms an auxiliary part of its educational apparatus. The machinery of all the shops is driven entirely by electric motors. The equipment and shop methods are first class in every particular.

The work of the department is designed to be such as will come under a very broad interpretation of the term "Mechanical Engineering." Technical work is offered in steam, electrical, mill and hydraulic engineering and architecture. The director of the Mechanical Engineering Department is A. R. Saunders.

"Death Loves a Shining Mark."

At the June meeting of the Western Society of Engineers, at Chicago, Mr. E. A. Rudiger read a paper on "Typhoid Fever and the Epidemic at Ironwood, Mich., in 1893."

It described the situation of Ironwood, a mining town of some 12,000 inhabitants, who very generally used the water of shallow wells for drinking purposes. The water supplied by the water works, although discolored, as all water from streams in a wooded country is, was not usually unwholesome. Upon an outbreak of typhoid fever in the town an investigation was made which resulted in the discovery of some carcasses of dead animals being found on the banks of a small stream that discharged into tho river a short distance above the water works intake. This stream also drained a portion of the town. The carcasses had been deposited there by a member of the Board of Aldermen and Committee on Health, who afterwards died of typhoid fever.

Engineering As a Profession.

We have so frequently written of this matter in our columns that we should feel it almost necessary to apologise to our readers for again introducing it, were not the question one of "humanities;" a subject which has interested man ever since the Miocene age, and will till Miocene becomes Archaean. It is to inaugurate the discussion which a letter—appearing in our columns last week—will, we hope, provoke, that we again take up the pen.

The case cited by our correspondent is by no means exceptional. Many and many are the fathers who find their sons, after having followed a science course, left on their hands non-bread-winners, and forced to seek some new occupation to gain a livelihood; but to say that this is the fault of the colleges, the college authorities, or, primarily, the founders, is, perhaps, too harsh and broad a statement. It may be urged that the colleges have sprung up to meet a demand—that they are designed for utility, and are not condiments or luxuries which produce the same want they are qualified to satisfy. True, if there are professors there should be pupils, but it should be remembered that in nearly all cases it is by public vote that a college of science is instituted, or at any rate by a large committee of influential men with philanthropic, and not selfish, motives. Whether they are mistaken or not is a question which will bear discussion.

But, furthermore, why should engineering as a profession be more risky than another? Are there not as many medical students entering our great schools annually as engineers our technical colleges? Is the law so much better? How many hundreds are there annually starting on the race for the silk gown? What becomes of all the young men of good parts and high education that our universities annually send out to look for bread? Poor Alma Mater, your loving care and your pride in them has not especially well fitted your sons for the world. Two thousand "engineers," perhaps, are turned out by the technical colleges annually, our correspondent thinks. That would indeed be terrible, were there no vacancies to fill. But there is one thing more terrible, and that is that not 10 per cent. of that 2,000 are fit to fill the gaps in the ranks. That is really the question to be faced with regard to engineering as a profession. Not the paucity of vacancies or the crowd of applicants; not the smallness of the wage or the aspirations of the earner; but the inability of the competitor. And are the colleges to be blamed if they fail to give a man the necessary qualifications to become a success in the engineering profession? That technical colleges have faults—and serious faults—

we admit, and indeed have been loud in crying out against them. But it must be understood that no education, were it ever so good, can insure a man's success if he lacks one thing—the knowledge of his fellow man. It would not be difficult to enumerate two score of successful engineers who have started without advanced mechanical instincts, and very little science. It would be difficult to count as many highly qualified men, other than professors, holding similar lucrative positions. After all, only a very small percentage of men owe a good income to advanced education.

Undoubtedly, parents are apt to make a mistake, and because a boy shows some taste for mechanical handicraft at home, to make an engineer of him. The genius in the nursery is rarely the eminent man in the world. It would seem that the very qualities that make him a wonder at home are those that render him ridiculous abroad. What is true of the prophet is rarely true of the mechanical man, for the engineer is too frequently without honor save in his own country and amongst his own kin. That too many youths plunge precipitately into a profession which they have not sufficiently studied is true; the "kid-glove apprentice" is at once the abomination and despair of a conscientious master. We have suggested before now a way of testing a boy's metal. Let part of his term in the shops be served before he passes the college curriculum, the remainder subsequently. The great objection to this is the boy's youth, and the bad influence and hardships of the shops. A lad's character, if he is ever going to be any good, should be formed sufficiently at 16 to prevent his falling a prey to those temptations or trials. We cannot go into the question further at present; in opening our columns to a broad discussion we feel that much good may be done in discovering and remedying such evils and mistakes as undoubtedly exist in the early stages of engineering as a profession.—*The Engineer* (London).

MANUFACTURES

The Cary tannery, at Brewer, Me., is erecting an addition.

The Woodstock Iron Co. will soon begin work at Anniston, Ala.

A tannery is to be erected at Waukegan, Ill., by Lanz, Owen & Co.

The citizens of Cuba Village, N. Y., will establish an electric-light system.

A new addition is being built to the Henderson foundry at Jefferson, Tex.

The plant of the Carbon Steel Co., Pittsburgh, Pa., is now running full time.

An addition is contemplated by the Union Springs (Ala.) Cotton Mills Co.

The Richmond (Va.) Brick Works are to erect buildings and increase output.

Greene & Seaman will shortly erect a foundry in Arkadelphia, Ark. Capital, $13,000.

The A. R. Rarig Iron Co. may rebuild its recently destroyed works at Buena Vista, Va.

The iron and nail workers at Williamsport, Pa., have adopted a profit-sharing system.

The Iron and Railway Co., of Embreeville, Tenn., will build a foundry during the summer.

A leather belting factory will be erected at Wilmington, N. C., by the Charlotte Supply Co.

A new foundry will be built this summer by the Harrison Boiler Works, of Philadelphia, Pa.

The Du Bois Broom Mfg. Co., of Du Bois, Penn., has leased larger quarters and is adding machinery.

The Kewaunee (Wis.) Iron Works are a new thing and will erect works and begin operating at once.

Business is improving at the foundries of D. S. Spaulding and Cobb & Evans, at Mansfield, Mass.

The St. Louis (Mo.) Wringer Mfg. Co. has recently increased its capital stock and will make additions.

B. J. Parker and others will erect machine shops in Bardow, Fla. One hundred men will be set at work.

It is said that Chicago elevated railroad companies are in the market for 70,000 tons of structural material.

The Leon Smith Co., of Houston, Tex., has been formed to manufacture hosiery. The capital stock is $10,000.

At Rochester, N. H., one of the Wallace shoe shops has started up, with power furnished by electric motors.

A new machine shop is being built by Amelott & Co., Spencer, Mass., to be ready for occupancy next month.

The Sweet Electric and Manufacturing Co. has been organized this week in Grand Rapids, Mich. Capital, $30,000.

The G. T. Eames Mfg. Co. has been organized in Kalamazoo, Mich., for the purpose of making drills. Capital, $15,000.

The E. B. Eddy Manufacturing Co., Hull, Que., will shortly change its present wood-mills into a paper-mill and a paper bag factory.

W. Simmonds and others have formed the Simmonds Hat Mfg. Co., of Yonkers, N. Y., with a capital of $10,000.

The Geo. W. Payne & Co., Pawtucket, R. I., will erect a handsome four-story block, to be finished by October next.

The Superior Stove Works have been incorporated in Cleveland, O., to erect works in which to make stoves. Capital, $10,000.

The Samson Manufacturing Co. has been organized in Hartford, Conn., to manufacture machinery and hardware. The capital is $10,000.

A new engine is to be put at the Richard Borden Mills, Fall River, Mass. The cylinders are 28 and 54 inches in diameter, by five feet stroke.

In Hamilton, Ill., there has been incorporated the Ryan Dynamo Co. with a capital of $13,000 to make dynamos. C. H. Cornell is interested.

The machinery is being put in at the new factory of the Pearl Square Auger Co., Manchester, N. H., and the concern will soon be running.

The Dental Mfg. Co. has been organized in Washington, D. C., with $50,000 capital, and will make dental specialties. J. W. Simmons, president.

The Graham Equipment Co. have established a plant between the Nicholson File Works and the Stafford Manufacturing Co., Providence, R. I.

The Rogers Manufacturing Co., makers of bone goods at Rock Falls, Conn., whose factory was burned recently, have decided to rebuild on the old site.

The Benjamin Machine Co. has been organized in Reed City, Mich., by Fred S. Benjamin and others with capital of $75,000, and new works will be erected.

The Edgar Thomson Works, Chicago, is piling up coke preparatory to starting. The works had a month's supply when the strike in the Connellsville regions closed the ovens.

The Overman Wheel Co., Chicopee, Mass., has begun work on the old Broadway schoolhouse of that city, and will remodel it and prepare it for use as a factory.

The Gasoline Engine Works, Lansing, Mich., issue a catalogue illustrating and describing the gasoline engines built at the works. A long list of testimonials is appended.

The Acme Index Co. has been organized for the purpose of making printing machinery, and will erect a plant in Baltimore, Md. Capital, $15,000. Freeman F. Philbrick and others incorporators.

The McShane Manufacturing Company, of Baltimore, Md., gave notice this morning to their 1,000 employes that, owing to the improved condition of trade, their wages would be raised 10 per cent.

A telegram from Scottdale, Pa., June 18, says: The Scottdale Iron and Steel Co. this morning started its plant in full. One-half of the mill has been running all winter, but the increase of orders warranted the entire mill being put in operation.

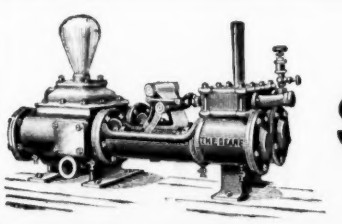
The Clayton Air Compressor Works, 26 Cortlandt street, New York, have issued a pamphlet devoted especially to the illustration and description of air compressors for operating pneumatic carving and calking tools, and riveters. These are of various types, steam and belt driven, horizontal and vertical. The pamphlet is sent upon application.

MASON REGULATOR CO., Boston.

YOUR No. 000 PUMP

has been placed on Str. "Riverside," of Continental Steamboat Co., and works like a charm; everybody who saw was well pleased with it. The other pumps owned by the Company, are not in it with the Mason, at least, so the Manager thinks.

(Signed) PROVIDENCE ENGINEERING CO.,
Providence, R. I.



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STEAM PUMPS
DEANE STEAM PUMP CO.,
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Birmingham ("Stubs") Wire Gauge Sizes,
SCREW GAUGE SIZES AND SIZES IN FRACTIONAL PARTS OF AN INCH.
For BICYCLE REPAIRERS, ELECTRICIANS and others.
Adjustable Dies with Case-hardened Guides.
Send for Supplement No. 1.
WILEY & RUSSELL MFG. CO.,
GREENFIELD, MASS., U. S. A.

THE ENCYCLOPEDIA OF FOUNDING
And Dictionary of Foundry Terms Used in the Practice of Molding. By SIMPSON BOLLAND,
Practical Molder and Manager of Foundries; Author of "The Iron Founder," "The Iron Founder Supplement," etc. 12mo, Cloth, $3.00.
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Ready Made Cut Gears.
Ready Made Cast Gears.
Ready Made Brass Gears.
Gears Made to Order.
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Gear Book, 15 cents.
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Gear Cutting Machines.
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SAVES LABOR in being able to run at GREATLY INCREASED SPEEDS. FEWER GRINDINGS. No WASTE in redressing.
SOLE REPRESENTATIVES IN THE UNITED STATES.
B. M. JONES & CO.,
BOSTON: 11 & 13 Oliver St., NEW YORK: 143 Liberty St.

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TUITION FREE. LA FAYETTE, IND.

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We are building them in various sizes from 10 inch to 24 inch swing, in various lengths, both engine and speed lathes. Our designs are the latest and most approved, while the workmanship, material and finish are of the highest order. Our catalogue will tell you all about them, as well as of our planers, shapers, drills and other tools and supplies. A postal will bring it. Write us for prices.
SEBASTIAN LATHE CO.,
117-119 CULVERT ST., CINCINNATI, OHIO.

BORING AND TURNING MILLS.
37, 51 and 62-Inch Swing, with Two Regular Heads.
42-INCH SWING, WITH TURRET HEAD, AND SCREW CUTTING ATTACHMENT.
All gears accurately cut. All feeds positive.
Machines are self-contained and therefore do not require an expensive foundation.
BRIDGEPORT MACHINE TOOL WORKS,
E. P. BULLARD, Prop. BRIDGEPORT, CONN.
New York Office, 86 LIBERTY STREET.

ASBESTOS
SMOKE STACK PAINT
Used on the ships of the U.S. Navy and by the prominent Steamboat and Transportation Companies.
The only paint supplied in colors which has given absolute satisfaction where forced draught is used.
READY FOR USE
ALL ORDINARY SHADES.
H. W. JOHNS M'F'G CO.
87 MAIDEN LANE, NEW YORK.
NEW YORK JERSEY CITY CHICAGO PHILADELPHIA BOSTON LONDON

John W. Reynolds has purchased of the heirs of Arnold Harris the foundry and machine shop property in Ford street, Ballston, N. Y., known as the Harris foundry. Mr. Reynolds will erect a new foundry and expects to have it completed about August 1st.

The Standard Light and Power Company have bought the Kinney Mill site in the eastern part of Berlin, N. H. There is a good water power at this point, which will be utilized to extend their business, as it becomes necessary to supplement their present power.

The Burden Seamless Filled Wire Company will erect an extensive plant at Providence, R. I. Electric power will be employed. The power house will be of two stories, containing in addition to the engines, boilers, generating plant, etc., a repair and a store room.

The Pittsburgh Wire Company, with works at Braddock, has made several changes among the officials. The present officials are as follows: John Bindley, president, who succeeded A. Dempster; T. W. Fitch, secretary and superintendent, and W. H. Cochrane, treasurer.

The Lodge & Davis Machine Tool Co., of Cincinnati, O., have just been awarded a contract by the United States Government for one of their improved screw machines to work stock up to 1¼ inches, to be shipped to the Norfolk navy yards, Norfolk, Va.

The Carborundum Company, Monongahela, Pa., has issued a price list of Carborundum wheels. All wheels over three inches diameter, made by this company, are turned after firing. They are made in seven degrees of hardness, and of various qualities as to fineness.

The Detroit Foundry Equipment Co. have changed their name to Whiting Foundry Equipment Co. They have removed their main office to 225 Dearborn street, Chicago, and have occupied they new works at Harvey, Ill. Correspondence should be addressed to the Chicago office.

Articles of incorporation have been issued to George Hoyt, J. M. Gorham. S. H. Curtiss, L. A. Cobb, A. T. Ballantine, and James T. Sargent, as the Automatic Refrigerating Company, of Cleveland, with a capital stock of $25,000, for the purpose of acquiring certain patents, and manufacturing refrigerators and other articles of wood and iron.

From inquiries among the different iron manufacturers of Youngstown, Ohio, on June 18th, it was learned that as soon as they can obtain coal all the mills will go to work. The blast furnaces are nearly all out of pig metal and have big orders to fill. The Youngstown Bridge Company has enough work ahead to keep its works going a long time as soon as it can get iron.

We have received from the American Tube Works, Boston, Mass., a very neat book, suitable for carrying in the pocket, which gives all the information regarding brass and copper tubing which users of such tubing usually desire in connection with orders, designing, etc. The rear portion of the book contains a number of cross-ruled pages for memoranda, sketches, etc.

The Robinson-Rea Manufacturing Company, Pittsburgh, is making a new housing for the Lalance-Grosjean Manufacturing Company, of Harrisburg, Pa., also a pair of cold rolls, which, when coupled with the present train, will give a new stand of cold rolls. The company is also making a pair of 30-inch tin-mill rolls, the intention of the Harrisburg Company being to have a complete plant for making tin and terne plate.

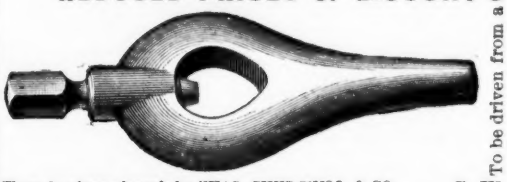
The Cleveland Twist Drill Company have just shipped three of each size of their grip sockets to the Norfolk Navy Yard. This is the third navy yard that has been equipped with these grip sockets, which the Cleveland Twist Drill Co. have lately introduced to the market. Many of the largest manufacturers throughout the country have adopted them for their works, and the Twist Drill Company are hard pushed to keep up with their orders.

The Washington (Pa.) *Observer*, June 13th, says: "The largest yield of finished iron ever produced from two furnaces in the Tyler rolling-mills was turned out Monday. Furnace No. 1, George Seavey, heater, produced 34,935 pounds of finished iron in seven heats. George Keil, heater of furnace No. 3, 34,880 pounds of finished iron in seven heats, or 69,815 pounds from the two furnaces. The size of the iron which was rolled was 8⅝ inches wide, by No. 9 gauge thick. Out of this large yield there was less than 150 pounds cut up as bad. Charles Kochendarfer was the roller."

A. G. Spalding, of Chicago, Ill., president of the Lamb Manufacturing Company, was at Chicopee Falls recently and consulted with the manager, T. C. Page, in regard to making a large addition to the factory. Plans have been drawn and work on the new buildings will be hastened. The new addition will adjoin the present main building and will be of brick, 250 feet long, 45 feet wide and four stories high. The new building will be fitted with the best machinery and will cost when completed about $50,000. The company will also erect an engine and boiler-house in which they will place a new 200 horse-power Corliss engine. They expect to have the addition completed by fall.

The contract for building the new felt mill, at Greenbush, N. Y., has been awarded to the Flynt Building and Construction Company, of Palmer, Mass. Work commenced Monday, June 18th, and is to be completed in August. The main building will be 257 feet long, 60 feet wide, three stories with basement, with an addition in the rear 70x80 feet for boiler and power house. The plant will have a wool storage building 50x150 feet and a side track from the Hudson River Railroad running directly to it. The whole has been planned by the well known firm of mill architects and engineers, Lockwood, Greene & Co., of Boston, and promises to be one of the most complete plants for woollen manufacturing in the State. The buildings will be what is known as slow-burning mill construction, and provided throughout with a sprinkler system, will be practically fire-proof.

REDUCED PRICES OF LECOUNT'S STRAIGHT TAIL DOG.

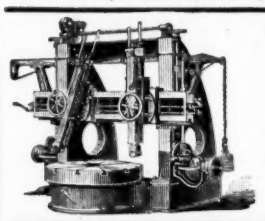


To be driven from a Stud in the Face Plate.

No.	INCH.	PRICE.	No.	INCH.	PRICE.
1	¾	$0.60	10	2¾	$1.35
2	⅞	.70	11	2⅞	1.45
3	1	.70	12	3	1.60
4	1⅛	.80	13	3⅛	1.80
5	1¼	.80	14	4	2.10
6	1⅜	.95	15	4½	2.75
7	1½	.95	16	5	3.25
8	1¾	1.10	17	5½	4.00
9	2	1.20	18	6	5.00
1 Set to 2 in.		7.80	Full Set,		$31.10

These Goods are for sale by CHAS. CHURCHILL & CO., L'td, 21 Cross St., London, England.

C. W. LeCOUNT, South Norwalk, Conn.



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14 SIZES FROM 5 TO 20 FEET.
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14-inch Engine Lathe.

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FROM 1 TO 40,000 POUNDS WEIGHT.
Of Open Hearth, Chester or Bessemer Steel.
True to Pattern. Sound. Solid.
GEARING OF ALL KINDS, CRANK SHAFTS, KNUCKLES FOR CAR COUPLERS.
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Steel Castings of Every Description.
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FOR TOOLS, DRILLS, DIES, &c.
ALL KINDS IN STOCK.
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Established a century ago.
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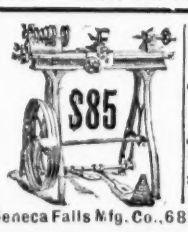

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Screw Cutting Automatic Cross Feed, etc.
Scroll Saws, Circular Saws, Lathes, Mortisers.
Catalogue Free of all our Machinery.
Seneca Falls Mfg. Co., 687 Water St., Seneca Falls, N.Y.

BUILDERS IRON FOUNDRY,
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300 TONS LARGE AND HEAVY CASTINGS,
MACHINE FINISHED.
Just ordered for more prompt delivery than would be possible for an ordinary establishment. Further orders are solicited.

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INSIST ON HAVING NICHOLSON.
NICHOLSON FILE CO.
PROVIDENCE, R. I., U. S. A.
3000 VARIETIES FILES
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FRANK L. WILCOX, Treasurer. GEO. H. SAGE, Secretary.

Engineers, Architects and Builders of

Iron and Steel Bridges and Buildings.

The above illustration, taken direct from a photograph, shows the interior of an Iron Foundry designed and built by us for The Farrel Foundry and Machine Co., at Ansonia, Conn. The building is 129 feet in width by 302 feet in length. The wings are 30 feet and 43 feet respectively, and the central portion is 56 feet in width. The central portion of the building is controlled by a hydraulic traveling crane, with a travel the full length of the building, and is also arranged with jib cranes for delivering material from the traveling crane to the cranes in the wing trusses.

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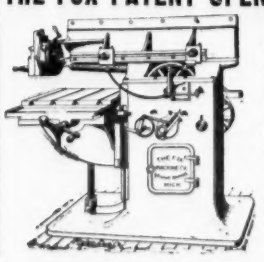

No springing of ram. No overhanging table. Quick Return, Stroke Under Perfect Control. Can be Instantly Adjusted 1 16 in. or 24 in. No Screws to Monkey with. Powerful, Quick, Accurate. Write for circular.
The Fox Machine Co.,
325 N. Front St.,
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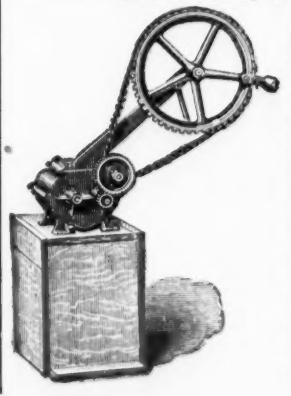
135 Finsbury Pavement, London, England.

ROOTS' NEW ACME HAND BLOWER.
For Blacksmiths, etc. Slow Speed, Positive Blast. Is Durable, Compact and Cheap; also Portable Forges, Tuyere Irons and Foundry Blowers.



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SIMPLE, COMPOUND, OR TRIPLE EXPANSION, HORIZONTAL OR VERTICAL
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ST. LOUIS, Eighth and St. Charles Sts.

Fraser & Chalmers, Chicago, Ill., have issued a second edition of the catalogue of the Riedler pumping engine, used extensively in mines. In this pump the valves are positively moved, making their action certain.

Machinists' Supplies and Iron.

NEW YORK, June 27, 1894.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $12.50 to $13.00; No. 2, $11.25 to $12.00; Gray Forge, $10.25 to $10.50. Southern brands are quoted at $11.50 to $12.25 for No. 1 Foundry; $10.50 to $11.00 for No. 2, and $10.00 to $10.25 for No. 3.

Antimony—The market is dull and weak. We quote L. X., 8⅞c. to 9c.; Cookson's 10c. to 10¼c.; Hallett's, 8.50c. to 8.60c., and U. S. French Star, 10c.

Lard Oil—Prime is quoted at 56c. to 58c.

Copper—There are no changes in the market. Lake Copper can still be bought at 9.15c. Casting Copper is held at 8.65c. to 8.75c.

Lead—The market remains steady at 3.35c., but there is some likelihood of lower prices in the near future.

Spelter—The feeling is quiet and steady. Early New York sales are offered at 3.45c., and for future months the lowest quotation is 3.50c.

Tin—The market continues dull and easy at 19.40c. Car loads for prompt delivery are quoted at 19.40c. to 19.45c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

An exp'd designer and draftsman on fine mach'y, wants a position. BOX 113, AM. MACHINIST

Draftsman—Mech. grad. from tech. school and 5 yrs. exp. want pos. Wm. Dieter, 657 Kosciusko St., Brooklyn, N. Y.

Wanted—A master mechanic to take entire charge of shops employing 250 men; must have wide experience. BOX 109, AMERICAN MACHINIST.

Wanted pos. as foundry foreman; 10 yrs. on heaviest class of engine, machine, tool and jobbing; economical manager. Address M. D., AM. MACHINIST.

General and business manager wanted for large steel casting concern, with large important specialties. Only those familiar with the manufacture of steel, and of proved high executive and business ability need apply. Wilson, 51 Tribune Building, N.Y.

Wanted position as foreman or superintendent of foundry; capable and of large experience in all classes of foundry work: well up in modern methods and appliances and can handle men to advantage; A1 references. BOX 115, AMERICAN MACHINIST.

MISCELLANEOUS WANTS

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Wanted—To buy good second-hand tools. Box 83, AMERICAN MACHINIST.

Wanted—Makers to deliver machines for liquorice manufactory. Prepaid offers to R. A. 6863, care G. L. Daube & Co., at Cologne, Germany.

Introduction and negotiation of American patents and machinery to English manufacturers and agents. Write for circular to Geo. Richards, M. I. M. E., Mechanical and Consulting Engineer, No. 5 Laurence Pountney Hill, London, England.

Do you want a picture of the famous Locomotive "999?" Send 50 cents for our fine copper plate *transparent* picture (14x28), showing all parts *inside* and *outside*, all named and numbered, on satin gloss paper, for framing, educational, beautiful, correct. Locomotive Engineering, 256 B'way, N.Y.

Information Wanted—Advertiser is a 1st-class tool maker, die maker, and expert machinist. Also a good d'tsman and designer of mach'y. Is seeking location to establish a small jobbing machine shop where there is reasonable prospect of success. Information acknowledged with grateful thanks. All letters answered. Wm. E. Piper, 7639 Drexel Ave., Chicago.

An engineer's widow has a complete set of back volumes of the AMERICAN MACHINIST since 1881, which she wishes to sell, together with paid-up subscription to AMERICAN MACHINIST, for $20. Some of the volumes are bound and some unbound, but every number is in perfect condition. Address Mrs. O. A Lanphear. 967 Dennision Ave., Columbus, O.

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No More Twisted Tangs.

Larger drills can be used with smaller shanks than ever before. No charge for the groove in the shanks.

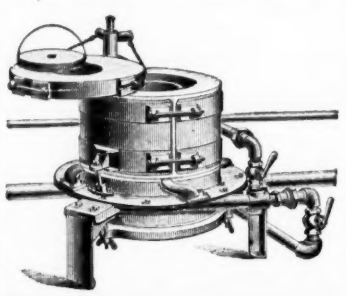
Send for Descriptive Price List.

Cor. Lake and Kirtland Sts., Cleveland, Ohio.

AMERICAN GAS FURNACE CO.,

OIL GAS PLANTS

Gas Blast Furnaces & High Pressure Blowers



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DETROIT TWIST DRILL CO., DETROIT, MICH., U. S. A.

SOLE MANUFACTURERS OF

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Endorsed by Practical Mechanics Everywhere. Send for Catalogue.

Lathes, Planers, Drills, Shapers,

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Now remaining unsold in the Engine and Boiler Shop, will be closed out at once.

IRON PLANERS.

19 in. x 3 ft Wheeler.
20 " x 4 " Lathe & Morse.
24 " x 4 " Blaisdell.
24 " x 5 " New Haven.
24 " x 6 " Powell "Latest."
26 " x 7 " N. Y. S. Eng. Co.
26 " x 8 " Pease.
30 " x 10 " Pease
32 " x 6 " Wood Light.
36 " x 10 " Gleason.
60 " x 24 " Heavy Pattern.

SHAPERS.

6 in. Stroke, Crank.
8 " " Gould.
9 " " Hewes & Phil.
15 " " Hendey.
16 " " Gould & Eber.
22 " " Triple Geared.

DRILLS.

22 in. Swing Prentice.
26 " " Lodge & Davis.
26 " " Prentice Friction.
36 " " Cinti. complete.
48 " " Old Style.
Radial Drill, 86 in. complete.

MILLING MACHINES.

B & S. No. 1 Universal with Cutters, Arbors, &c. A1 order.
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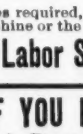

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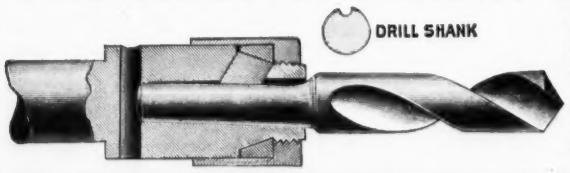

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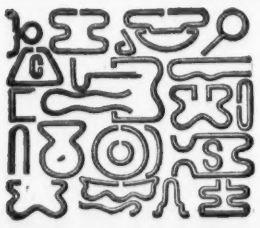

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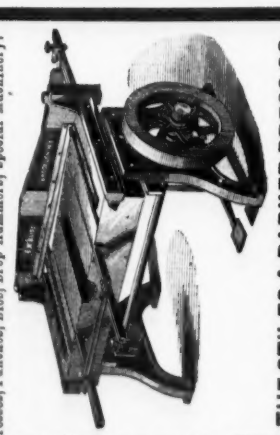

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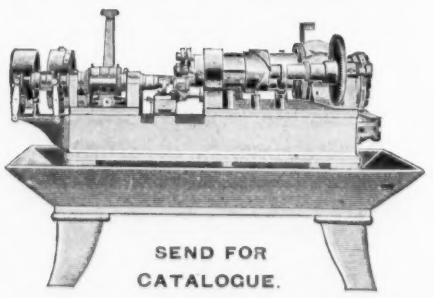

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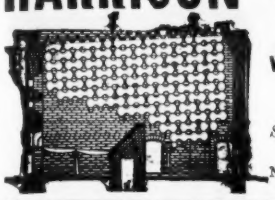

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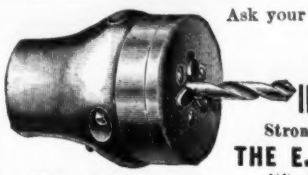

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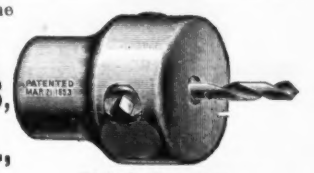

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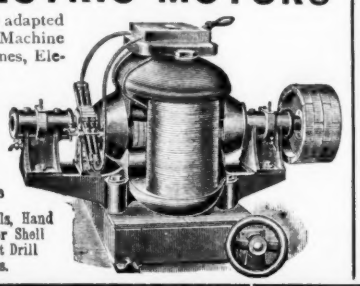

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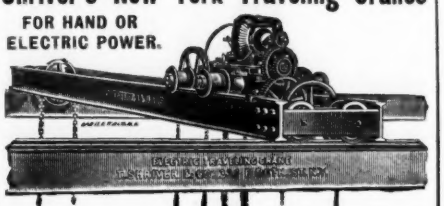

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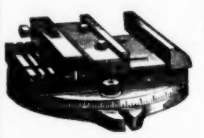

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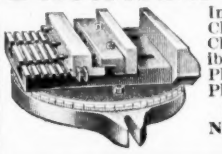

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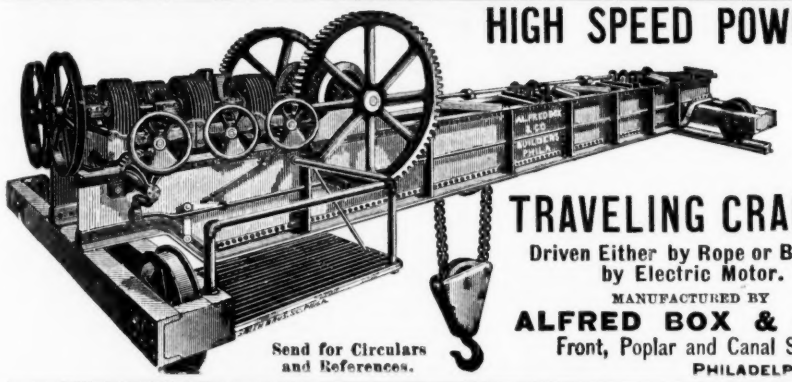

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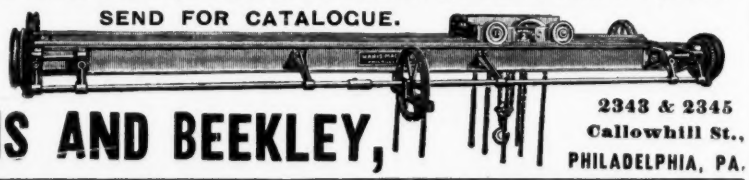

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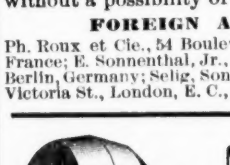

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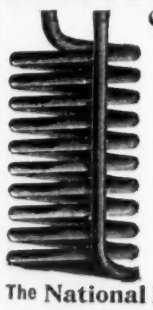

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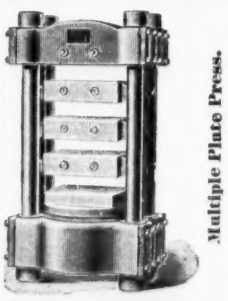

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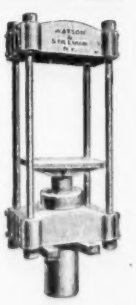

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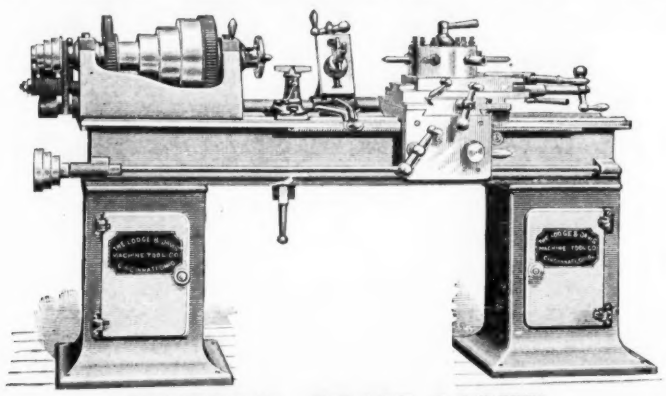

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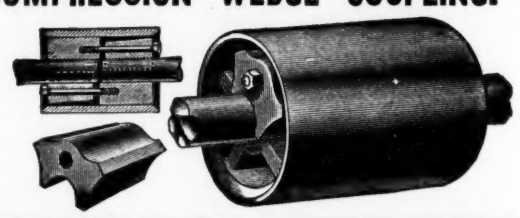

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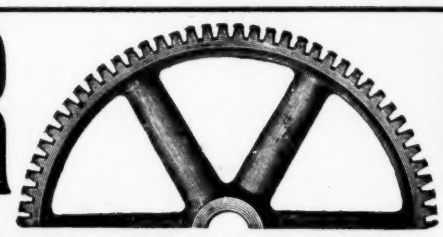

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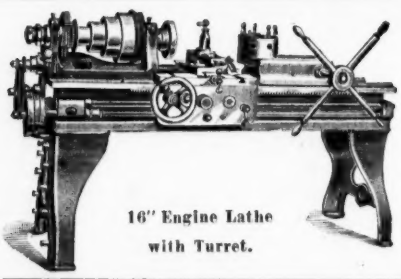

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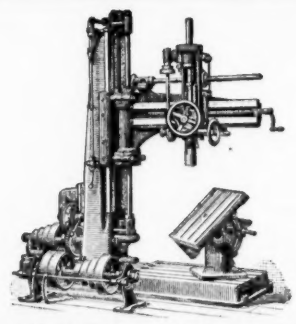

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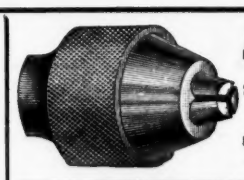

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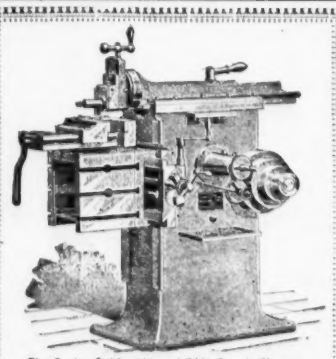

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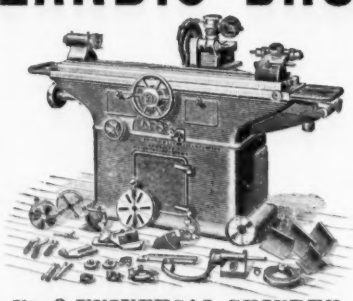

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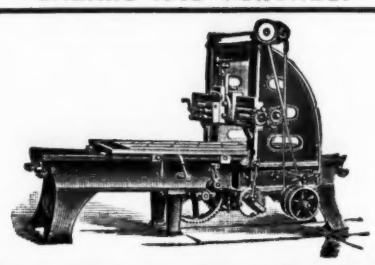

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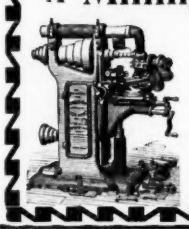

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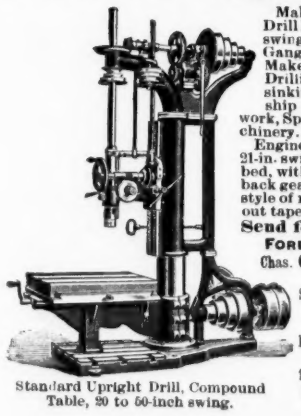

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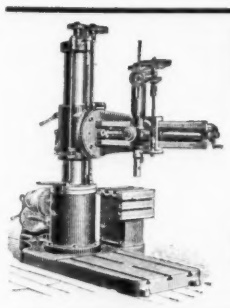

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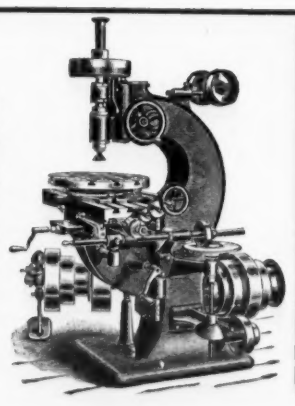

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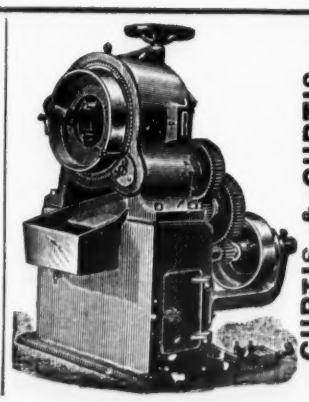

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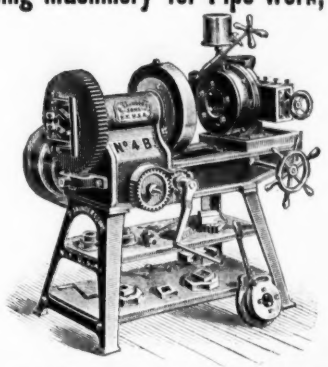

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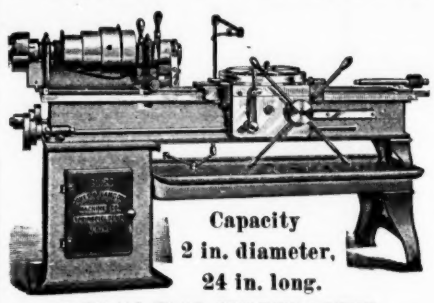

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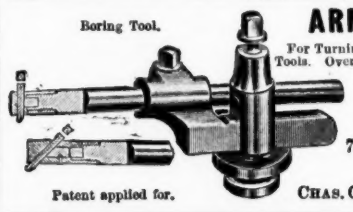

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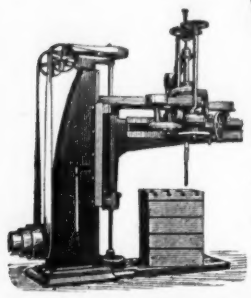

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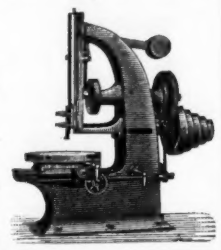

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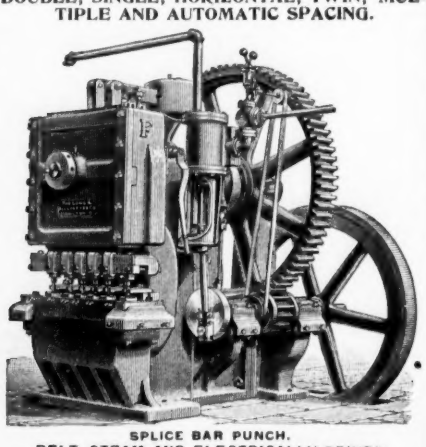

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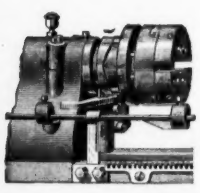

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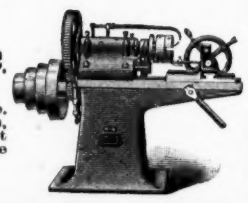

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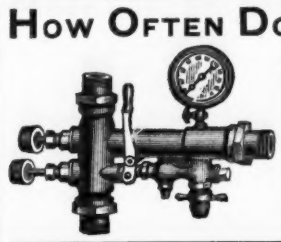

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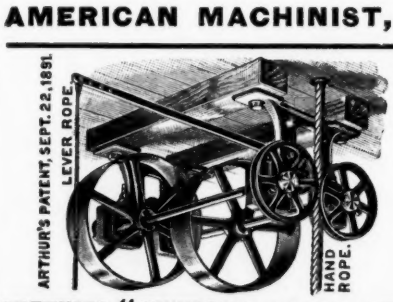

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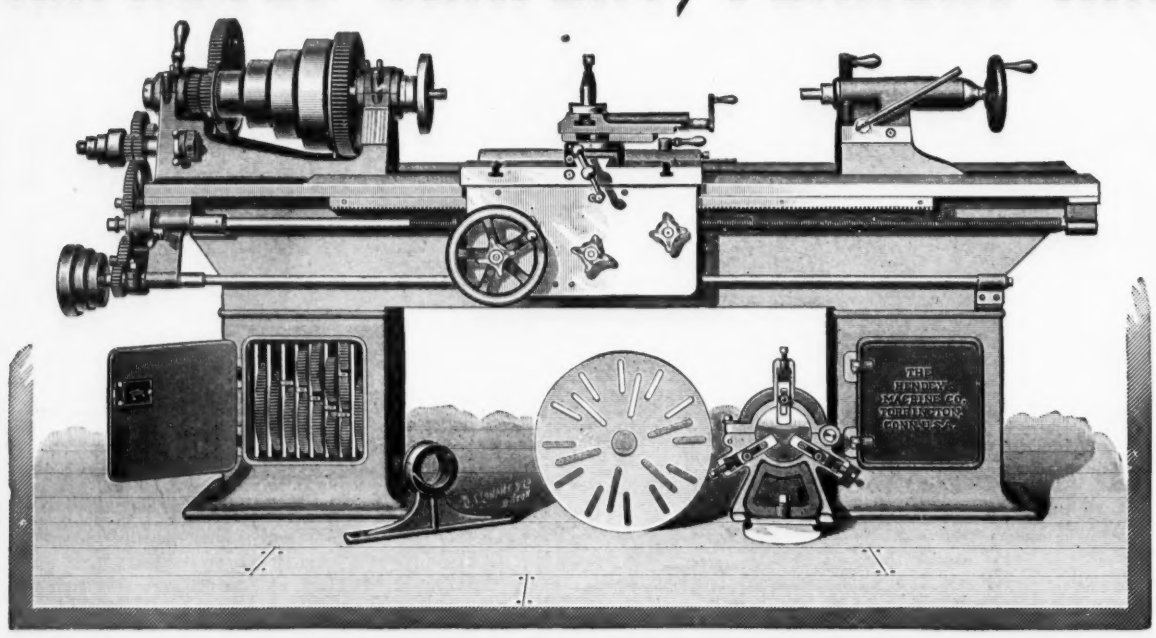

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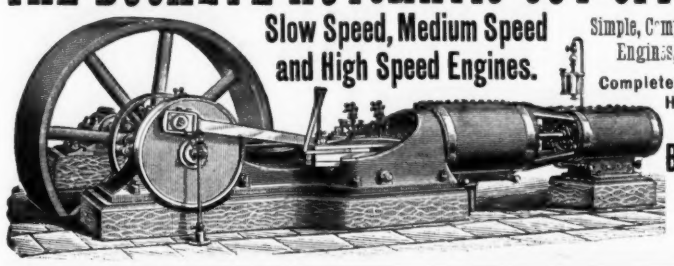

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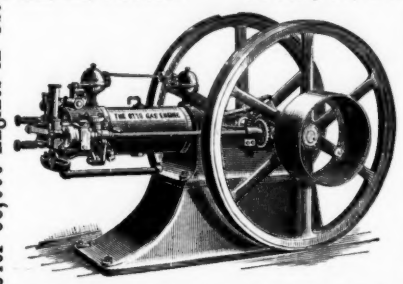

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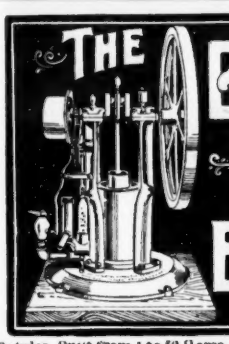

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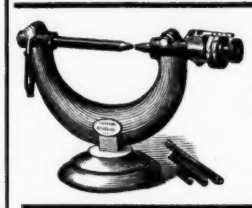

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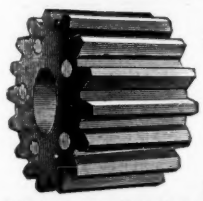

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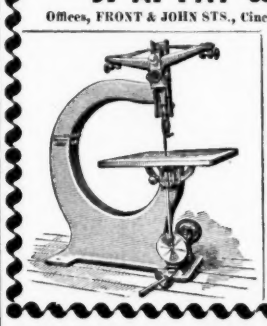

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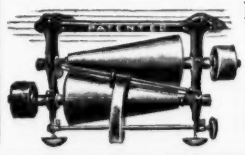

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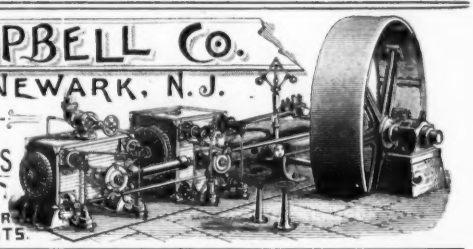

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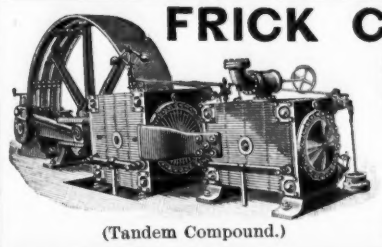

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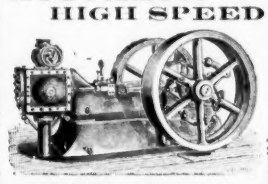

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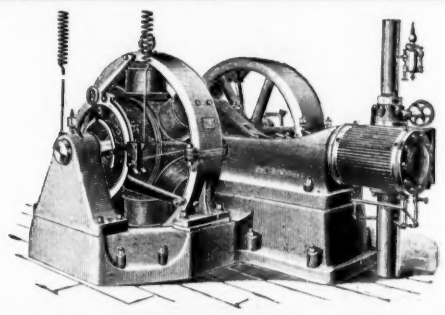

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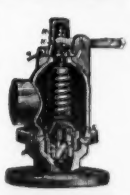

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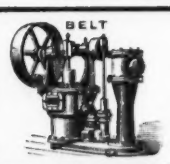

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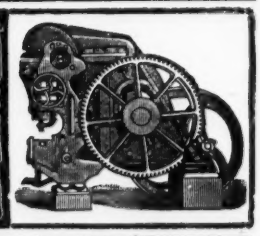

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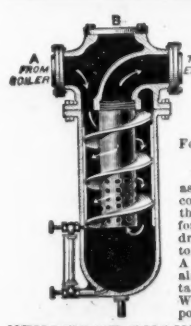

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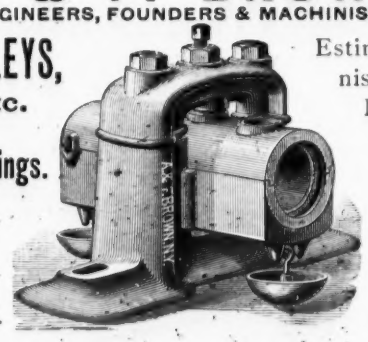

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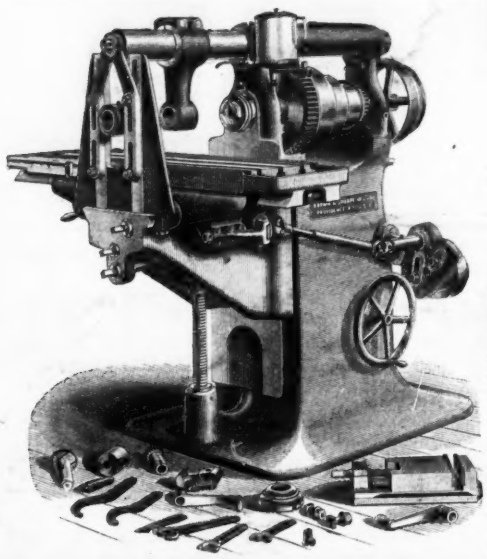

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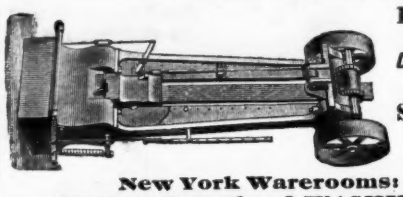

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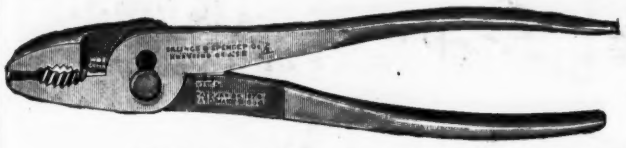

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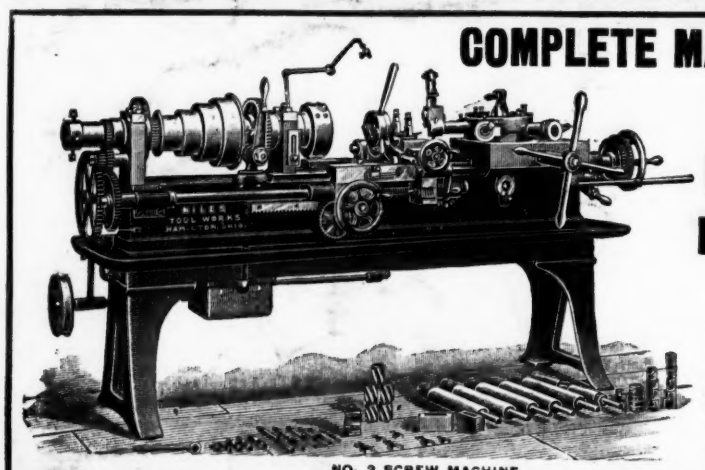

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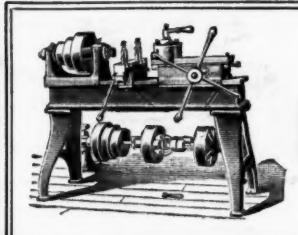

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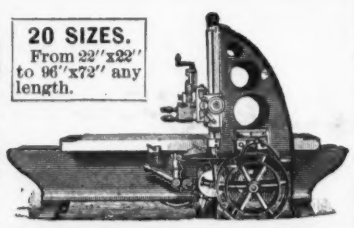

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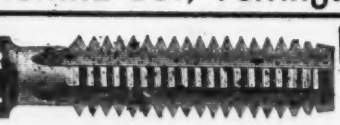

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